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Contamination Source Review for Building E3180, Edgewood Area, Aberdeen Proving Ground, Maryland

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Contamination Source Review for Building E3180, Edgewood Area, Aberdeen Proving Ground, Maryland

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Contamination Source Review for Building E3180, Edgewood Area, Aberdeen Proving Ground, Maryland

by

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Summary

This report was prepared by Argonne National Laboratory (ANL) to document the results of a contamination source review of Building E3180 at the Aberdeen Proving Ground (APG) in Maryland. The report may be used to assist the U.S. Army in planning for the future use or disposition of this building. The review included a historical records search, physical inspection, photographic documentation, geophysical investigation, collection of air samples, and review of available records regarding underground storage tanks associated with Building E3180. The field investigations were performed by ANL during 1994.

Building E3180 (current APG designation) is located near the eastern end of Kings Creek Road, north of Kings Creek, and about 0.5 miles east of the airstrip within APG's Edgewood Area. The building was constructed in 1944 as a facsimile of a Japanese pillbox and used for the development of flame weapons systems until 1957 (EAI Corporation 1989). The building was not used from 1957 until 1965, when it was converted and used as a flame and incendiary laboratory. During the 1970s, the building was converted to a machine (metal) shop and used for that purpose until 1988.

The physical inspection and photographic documentation of Building E3180 were completed in November 1994. The building is a single-story structure that contains six rooms. The main portion of the building measures 32 ft long, 14 ft wide, and 7 ft high; contains five rooms; and is constructed of 8-in.-thick cinder block exterior walls. This part of the building has a concrete floor and a flat, built-up asphalt roof over concrete panels. There are two cinder block extensions on the building: one pillbox extension on the east wall and a second extension on the north wall that houses an open (squirrel cage) ventilation system with a sheet-metal stack. Interior walls in this portion of the building are constructed of cinder block coated with white paint. A porch measuring 17 ft long, 6 ft wide, and 7 ft high extends from the west side of the main portion of the building. This porch has fine mesh wire screen walls supported by wood framing, a wood floor, a wood ceiling, and an asphalt roof.

At the time of the ANL inspection, one room of the building (room 5) was sealed, preventing inspection. Some of the other rooms contained electric heaters, lighting fixtures, electrical outlets, and electrical conduits attached to the walls and ceilings.

During June and July 1994, ANL staff conducted geophysical surveys in the immediate vicinity of Building E3180 by using several nonintrusive methods. Survey results suggest the presence of some underground objects near Building E3180, but they do not provide conclusive evidence of the source of the geophysical anomalies observed during the surveys.

Air quality samples were collected upwind, downwind, and inside Building E3180 in November 1994. Analytical results showed no distinguishable difference in the hydrocarbon and chlorinated solvent levels between the two background samples and the sample collected inside Building E3180. These results indicate that Building E3180 is not a source of volatile organic compound contamination.

No information regarding underground storage tanks associated with Building E3180 was available.

On the basis of information collected and reviewed by ANL for Building E3180, it is the authors' judgment that potential undetermined contamination could be present in room 5 of the building. No significant air contamination is associated with the other rooms in the building. Results of the geophysical surveys indicate some anomalies near Building E3180 that warrant further investigation and evaluation. An inspection and monitoring of room 5 is also recommended.

1 Introduction

The U.S. Army Aberdeen Proving Ground (APG) commissioned Argonne National Laboratory (ANL) to conduct a contamination source review to identify and define areas of toxic or hazardous contaminants and to assess the physical condition and accessibility of APG buildings. The information obtained from this review may be used to assist the U.S. Army in planning for the future use or disposition of the buildings. The contamination source review consisted of the following tasks: historical records search, physical inspection, photographic documentation, geophysical investigation, and collection of air quality samples. This report provides the results of the contamination source review for Building E3180.

Located on Chesapeake Bay in Harford and Baltimore counties, Maryland, APG occupies approximately 30,000 acres. The facility is divided into the Aberdeen and Edgewood Areas (Figure 1). The primary mission at APG has been the testing and evaluation of U.S. Army warfare materials. Since its beginning in 1917, the Edgewood Area of APG has been the principal location for chemical warfare agent research, development, and testing in the United States. APG was also used for producing chemical warfare agents during both world wars and has been a center for the storage of chemical warfare material (Nemeth 1989).

Many of the APG facilities constructed between 1917 and the 1960s are no longer used because of obsolescence and their poor state of repair. Because many of these buildings were used for research, development, testing, and/or pilot-scale production of chemical warfare agents and other military substances (such as incendiary materials or munitions containing these materials), the potential exists for portions of these buildings to be contaminated with these substances, their degradation products, and other laboratory or industrial chemicals. These buildings and associated structures or appurtenances (e.g., underground or aboveground storage tanks, pipes, sumps) may contribute to environmental concerns at APG.

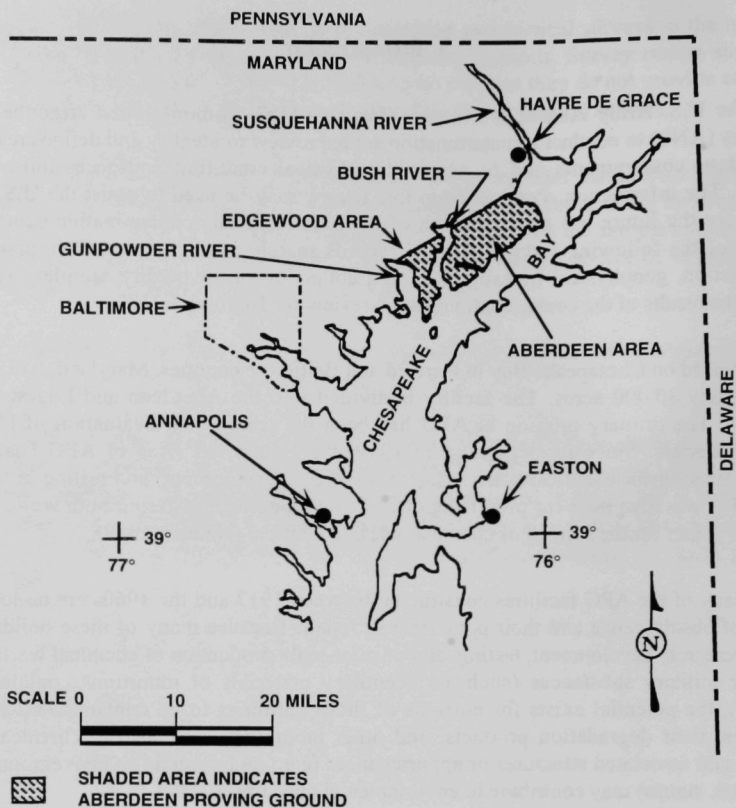


FIGURE 1 Map of Aberdeen Proving Ground Location

2 Methodology

Before the detailed building inspection, ANL personnel made a preliminary site visit to locate the building and obtain building records from APG, identify potential issues to be addressed in the health and safety plan, resolve any access restriction issues, and identify required support services.

Photographs were taken of the building's exterior and interior surfaces during the building inspection in November 1994. The photographs followed a set sequence whenever possible. The exterior was photographed starting on the north side and continuing clockwise around the building; walls were photographed starting in the north or northwest corner of each room and continuing clockwise until reaching the starting point. The ceiling and floor of each room were also photographed. No interior inspection or photographs were made in room 5 because the room was sealed.

The area around Building E3180 was examined during the summer of 1994 using several nonintrusive geophysical survey methods, including magnetic gradiometer, total-field magnetics, electrical conductivity (EM-31), induced electromagnetic field (EM-61), and ground-penetrating radar (GPR) techniques.

ANL staff collected air quality samples outside and inside of Building E3180 during November 1994. Organic compounds from 24-L samples trapped in a sorbent polymer cartridge were thermally desorbed and analyzed by using a gas chromatograph equipped with a mass spectrometer. Compounds were identified on the basis of mass spectral interpretation and a computer search of the 140,000 compounds in the Wiley spectral library.

Detailed descriptions of the methodologies used for the geophysical investigation and air quality monitoring are provided in the appendices to this report.

3 Historical Record Search

Building E3180 (current APG designation) is located near the eastern end of Kings Creek Road, north of Kings Creek, and about 0.5 miles east of the airstrip within APG's Edgewood Area (Figure 2). Building E3180 was constructed in 1944 as a facsimile of a Japanese pillbox (EAI Corporation 1989). The building was used by the research and development community in the development of flame weapons systems. The materials used in this effort and unknown. EAI Corporation also reports that the building was not used from 1957 until 1965.

The building was converted to a flame and incendiary laboratory in 1965 and employed for this purpose until the 1970s. Materials used during experiments were plasticized white phosphorous (PWP), white phosphorous (WP), eutectic white phosphorous (EWP), triethyl aluminum (TEA), napalm non-agent (unknown) thickener, red phosphorous, thermite, and magnesium. Only laboratory-scale amounts of incendiaries were used for the experiments, and all were consumed during testing (EAI Corporation 1989). Building E3180 was designed as a laboratory and listed as Building 379D in the 1966 and 1976 Facility Listings for APG (Nemeth 1989).

Building E3180 was converted to a machine (metal) shop in the 1970s and was employed for this purpose until 1988. Potential contaminants used during this period include petroleum, oil and lubricants (POL), and other (unknown) solvents. There is no record indicating that chemical agents were used in the building (EAI Corporation 1989).

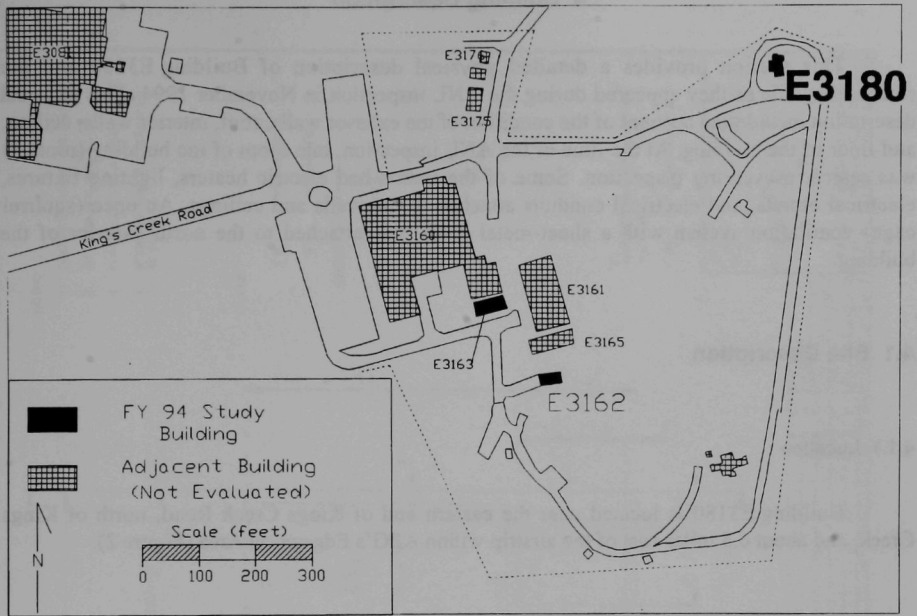


FIGURE 2 Map of Building E3180 Location

4 Building Description

This section provides a detailed physical description of Building E3180 and the surrounding site as they appeared during the ANL inspection in November 1994. This physical description includes an account of the condition of the exterior walls, roof, interior walls, ceiling, and floor of the building. At the time of the ANL inspection, one room of the building (room 5) was sealed, preventing inspection. Some of the rooms had electric heaters, lighting fixtures, electrical outlets, and electrical conduits attached to the walls and ceilings. An open (squirrel cage) ventilation system with a sheet-metal stack was attached to the north exterior of the building.

4.1 Site Description

4.1.1 Location

Building E3180 is located near the eastern end of Kings Creek Road, north of Kings Creek, and about 0.5 miles east of the airstrip within APG's Edgewood Area (Figure 2).

4.1.2 Proximity to Other Buildings

Building E3180 is located approximately 475 ft northeast of Building E3163 (Figure 2).

4.1.3 Building Structure

Building E3180 is a single-story structure that contains six rooms. The rectangular main portion contains five rooms, and is constructed of 8-in.-thick cinder block exterior walls with a concrete floor and a flat built-up asphalt roof over concrete panels. There are two cinder block extensions on the building: one pillbox extension near the northeast corner of the east wall and a second near the northwest corner of the north wall that houses an open (squirrel cage) ventilation system with a sheet-metal stack. A porch (room 6) with fine mesh wire screen walls supported by wood framing, a wood floor, a wood ceiling, and an asphalt roof extends from the west side of the main portion of the building. Figure 3 shows the building floor plan developed during the ANL inspection. Figure 4 provides photographs of the building exterior.



A	North Elevation
C	South & West Elevation

East & South Elevation	B
West Elevation	D

FIGURE 4 Photographs of Building E3180 Exterior

4.1.4 Exterior Dimensions

The exterior dimensions of the main portion of the building are 32 ft long by 14 ft wide by about 7 ft high. Dimensions of the east pillbox extension are 6 ft 10 in. long by 4 ft 3 in. wide by 5 ft 8 in. high. The ventilation system extension measures 6 ft 10 in. long by 3 ft 9 in. wide and 5 ft 8 in. high. The exterior dimensions of the porch are 17 ft 2 in. long, 6 ft wide, and about 7 ft high (Figure 3).

4.1.5 Topography

The area surrounding the building is flat.

4.1.6 Vegetation in the Immediate Vicinity

The building is surrounded by cut vegetation (lawn) with lone trees near the northeast and northwest corners of the building. Vines are growing around the ventilation system extension on the north wall of the building (Figure 4A).

4.1.7 External Aboveground Structures or Equipment

The sheet-metal stack for the open (squirrel cage) ventilation system is attached to the north wall of the building. Electrical service lines and electrical conduits are attached to the east side of the building. A pole with a red and blue light at the top extends about 3 ft above the roof near the south end of the east side of the building.

4.1.8 Connections with Adjacent Buildings

None.

4.1.9 Underground Structures

None.

4.1.10 Surface Drainage System

None.

4.1.11 Utility Access Points

None.

4.1.12 Exterior Piping

None.

4.1.13 Nearby Roads and Sidewalks

Kings Creek Road is approximately 25 ft south of the building.

4.2 North Exterior Elevation

4.2.1 Dimensions

The north exterior wall of the main portion of the building is 14 ft long and about 7 ft high. The ventilation system extension is 6 ft 10 in. long, extends from the main building wall 3 ft 9 in., and is 5 ft 8 in. high (Figure 3 and 4).

4.2.2 Construction Materials

The exterior walls of the of the main portion building and ventilation system extension are 8 in. thick cinder block.

4.2.3 Doors and Windows

None.

4.2.4 Piping

None.

4.2.5 Utility Connections

None.

4.2.6 External Equipment or Structures

The open (squirrel cage) ventilation system is attached to the north exterior of the building. The sheet-metal stack of the ventilation system extends approximately 15 ft above the roof.

4.2.7 Vegetation

The area north of the building is cut vegetation (lawn) with lone trees near the northeast and northwest corners of the building. Vines are growing around the ventilation system on the north wall of the building.

4.2.8 Overall Condition

The north side of the building is in good condition, but shows signs of weathering. The sheet metal stack of the ventilation system is rusted.

4.3 East Exterior Elevation

4.3.1 Dimensions

The east elevation of the building is 32 ft long and about 7 ft high. The pillbox extension is 6 ft 10 in. long, extends 4 ft 3 in. out from the main building wall, and is 5 ft 8 in. high (Figures 3 and 4).

4.3.2 Construction Materials

The exterior wall and pillbox extension are constructed of 8-in.-thick cinder blocks.

4.3.3 Doors and Windows

One 3-ft-wide by 7-ft-long metal door is located 10 ft 2 in. from the southeast corner of the east side of the building. The sealed, rectangular pillbox opening, measuring 5 ft wide and tapering to 2 ft 2 in., is 2 ft 11 in. from the northeast corner of the building. There are no windows on the east elevation of the building.

4.3.4 Piping

None.

4.3.5 Utility Connections

Two electrical power lines are connected to the east elevation of the building; one is attached at the roof line and the second is attached to a pipe extending approximately 3 ft above the roof. Electrical conduits are attached to, and enter, the east exterior elevation of the building.

4.3.6 External Equipment or Structures

A pole with a red and blue light at the top extends about 3 ft above the roof near the south end of the east side of the building.

4.3.7 Vegetation

The area east of the building is covered by cut vegetation (lawn).

4.3.8 Overall Condition

The east elevation of the building is in good condition, but shows signs of weathering. The electrical conduits are rusted.

4.4 South Exterior Elevation

4.4.1 Dimensions

The south exterior wall of main portion of the building measures 14 ft long and about 7 ft high. The porch on the west side of the building is 6 ft in wide and about 7 ft high (Figures 3 and 4).

4.4.2 Construction Materials

The south exterior wall of the main portion building is constructed of 8-in.-thick cinder blocks. The porch has a fine wire-mesh screen wall that extends from the roof to the floor and is supported by wood framing.

4.4.3 Doors and Windows

No doors or windows are located in the south exterior wall of the main portion of the building. A 3-ft-wide screen door is located near the west corner of the south wall of the porch.

4.4.4 Piping

None.

4.4.5 Utility Connections

None.

4.4.6 External Equipment or Structures

None.

4.4.7 Vegetation

The area south of the building is cut vegetation (lawn)

4.4.8 Overall Condition

The south exterior wall of the building is in good condition.

4.5 West Exterior Elevation

4.5.1 Dimensions

The west exterior wall of the main portion of the building is 32 ft long and about 7 ft high. The porch, located in the approximate center of the west wall of the main portion of the building, is 17 ft 2 in. long and about 7 ft high (Figures 3 and 4).

4.5.2 Construction Materials

The west exterior wall of the main portion of the building is constructed of 8-in.-thick cinder blocks. The porch has a fine wire-mesh screen wall that extends from the roof to the floor and is supported by wood framing.

4.5.3 Doors and Windows

Two doorways occupy the west exterior wall of the building. The first, which contains no door, measures 2 ft 8 in. wide and is located 3 ft 6 in. from the northwest corner of the porch. The second doorway, with a metal door, is 4 ft wide and located about 2 ft from the southeast corner of the west exterior wall. The metal door of the second doorway was sealed at the time of the ANL inspection. There are no windows in the west elevation.

4.5.4 Piping

None.

4.5.5 Utility Connections

None.

4.5.6 External Equipment or Structures

None.

4.5.7 Vegetation

The area west of the building is covered by cut vegetation (lawn).

4.5.8 Overall Condition

The west elevation of the building is in good condition, but shows signs of weathering. There is no door in the porch doorway.

4.6 Roof

4.6.1 Type and Dimensions

The building has a flat roof. The roof of the main portion of building is 14 ft wide by 32 ft long; the porch roof is 17 ft 2 in. long by 6 ft wide; the pillbox extension roof is 6 ft 10 in. long by 4 ft 3 in. wide; and the ventilation system extension roof is 6 ft 10 in. long by 3 ft 9 in. wide (Figures 3 and 4)

4.6.2 Height

The height of the roof is about 7 ft.

4.6.3 Surface Materials

The main portion of the building and the extensions have a built-up asphalt roof; the porch roof has an asphalt finish.

4.6.4 Support System

The roof on the main portion of the building and extensions is concrete supported by the exterior and interior walls. The porch roof is wood supported by wood rafters.

4.6.5 Condition

The roof of the building appeared to be in good condition.

4.6.6 Equipment Located on Roof

None.

4.6.7 Chimneys, Roof Vents, or Vent Stacks

Four sheet-metal vents extend approximately 2 ft above the roof of the building.

4.6.8 Piping

None.

4.7 Interior Floor Plan

4.7.1 Room Numbers and Dimensions

The main portion of the building contains five rooms. The dimensions of the individual rooms are listed below:

- Room 1: about 8 ft long by 7 ft wide;
- Room 2: about 9 ft 8 in. long by 5 ft wide;
- Room 3: 6 ft long by 5 ft 6 in. wide; and
- Room 4: 12 ft 4 in. long by 9 ft wide.

The dimensions of room 5, determined by exterior measurements, are assumed to be approximately 7 ft 6 in. wide by 12 ft 8 in. long. The porch, room 6, is 6 ft wide by 17 ft long. Figure 3 shows the floor plan of the building, developed during the ANL investigation.

4.7.2 Walls

The exterior walls of the main portion of the building (rooms 1 through 4) are white-painted, 8-in.-thick cinder blocks. The interior walls are white-painted, 4-in.- or 6-in.-thick cinder blocks. The exterior porch walls (room 6) are fine wire-mesh screen that extends from the roof to the floor and is supported by wood framing. The interior wall of the porch (room 6) is constructed of 8-in.-thick cinder blocks.

4.7.3 Floor

The floors of the main portion of the building (rooms 1 through 4) are concrete. The floor of the porch (room 6) is wood. Access to room 5 was prohibited, so the composition of the floor is unknown.

4.7.4 Floor Penetrations

No floor penetrations were noted in rooms 1 through 4 or room 6. Access to room 5 was prohibited, so floor penetrations could not be determined.

4.7.5 Interior Partitions

The interior walls or partitions are 6-in.-thick or 4-in.-thick painted cinder blocks.

4.7.6 Equipment or Supplies

Several electric heaters and fire blanket holders were observed in the building at the time of the ANL inspection. A small bench is attached to the corner of walls 1 and 2 in room 2.

4.8 Room 1

4.8.1 Walls

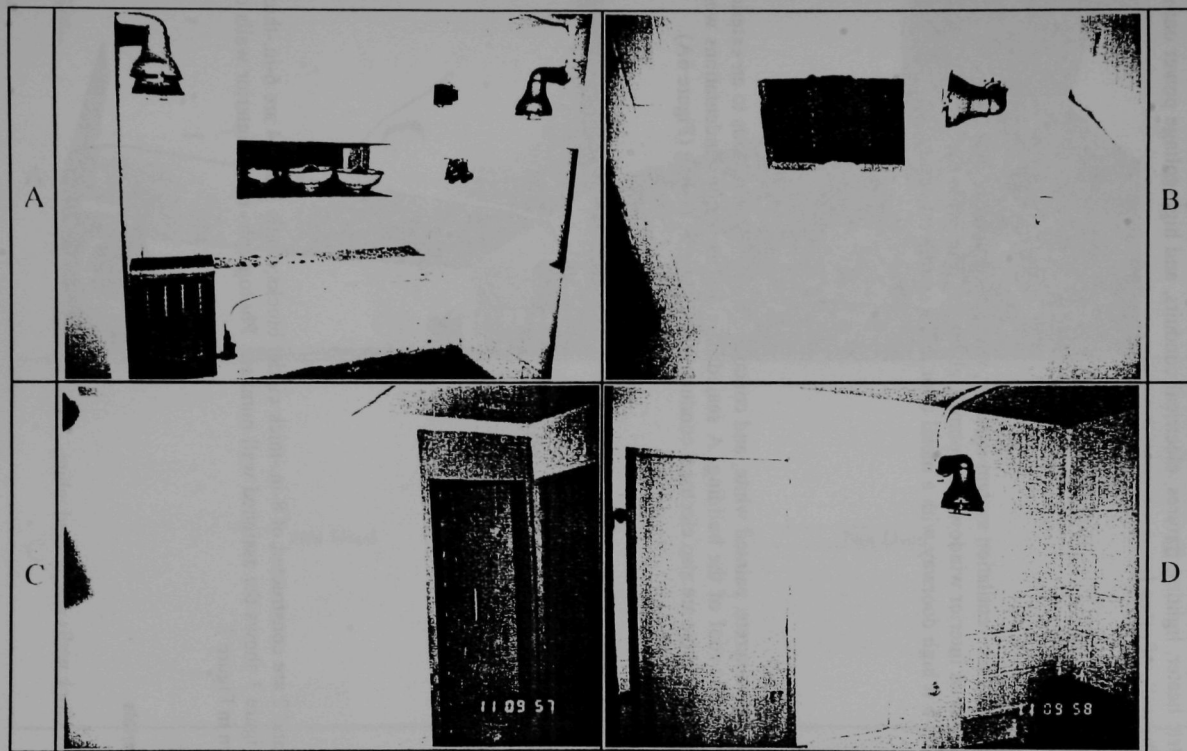
Walls 1 and 4 are constructed of 8-in.-thick cinder blocks. Wall 2 is 4-in.-thick cinder blocks, and wall 3 is 6-in.-thick cinder blocks. Figure 3 shows the assigned wall numbers. Photographs of the interior walls of room 1 are shown in Figure 5.

4.8.2 Finish Materials

The cinder block walls are painted white.

4.8.3 Piping

None.



A	Walls 1, 2
C	Walls 3, 4

Walls 2, 3	B
Walls 4, 1	D

FIGURE 5 Photographs of Room 1 — Walls

4.8.4 Equipment

An electric heater, lighting fixtures, electrical conduits, and high-voltage power outlets are attached to the walls of room 1.

4.8.5 Doors and Windows

Wall 1 contains the ventilation system opening, which measures about 4 ft 6 in. wide by 3 ft high. Wall 2 has an interior window into room 2, about 1 ft 5 in. wide by 2 ft high. Wall 3 has a 2-ft-wide by 6 ft high doorway with a metal door in the southwest corner. The door leads into room 3.

4.8.6 Ceiling

The ceiling is concrete, painted white, and contains an opening that leads to an exterior sheet-metal vent on the roof of the building. A sealed pipe and numerous indentations were observed in the ceiling. There are also electrical conduits attached to the ceiling (Figure 6A).

4.8.7 Floor

The floor in room 1 is concrete (Figure 6B).

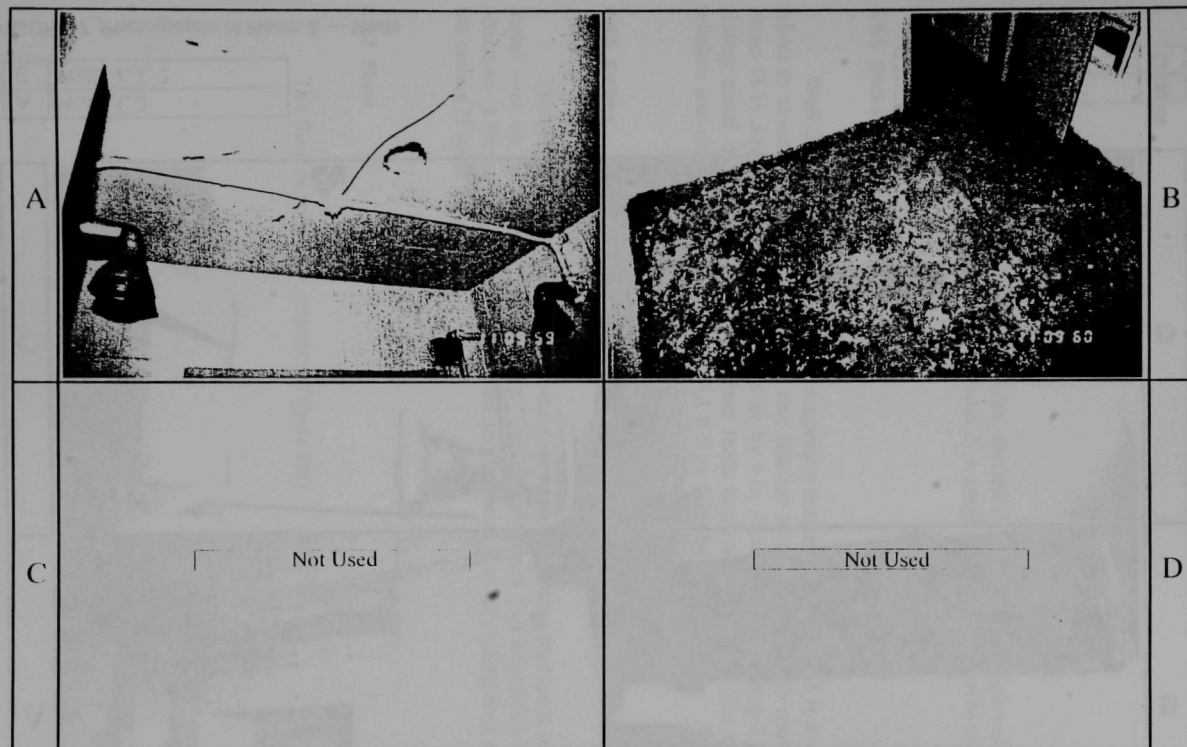
4.9 Room 2

4.9.1 Walls

Walls 1 and 2 are constructed of 8-in.-thick cinder blocks; walls 3 and 4 are 6-in.-thick cinder blocks. Figure 3 shows the assigned wall numbers. Photographs of the interior walls of room 2 are shown in Figure 7.

4.9.2 Finish Materials

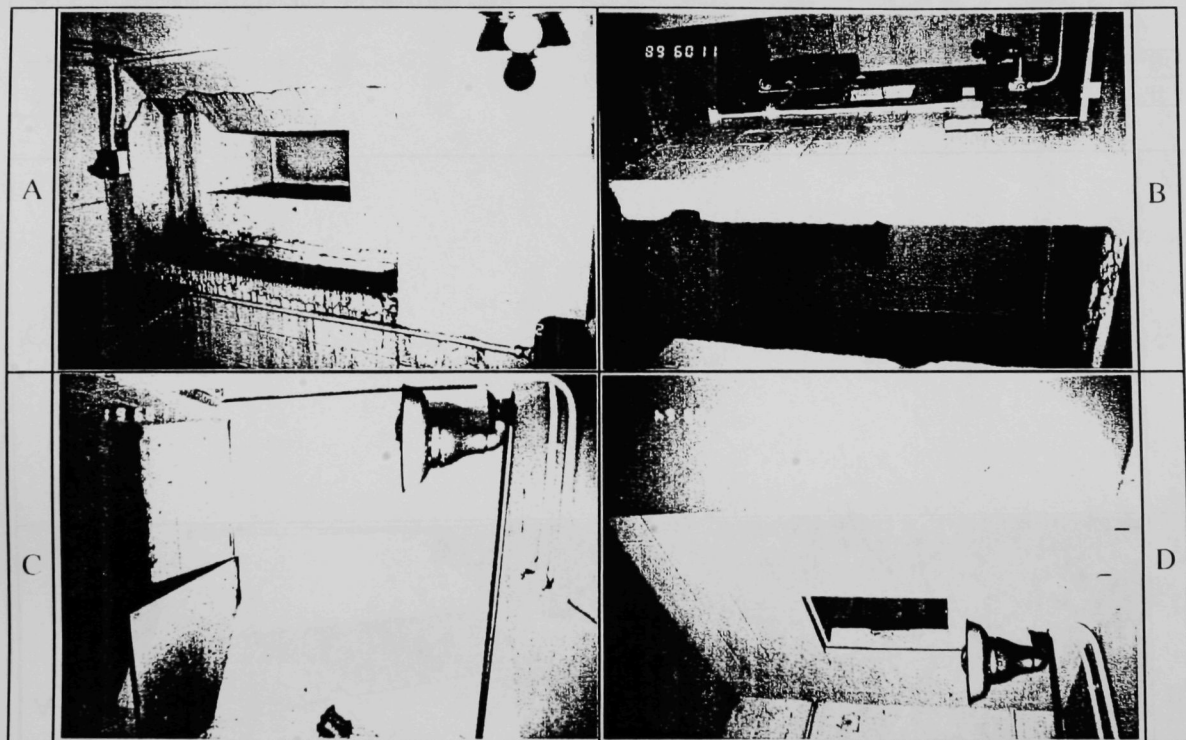
The cinder block walls are painted white.



A	Ceiling
C	Not Used

Floor	B
Not Used	D

FIGURE 6 Photographs of Room 1 — Ceiling and Floor



A	Walls 1, 2
C	Walls 4, 1, 2

Wall 3	B
Walls 4, 1	D

FIGURE 7 Photographs of Room 2 — Walls

4.9.3 Piping

None.

4.9.4 Equipment

An electric heater, lighting fixtures, electrical conduits, and high-voltage power outlets are attached to the walls and ceiling of room 2. A small bench is attached to walls 1 and 2.

4.9.5 Doors and Windows

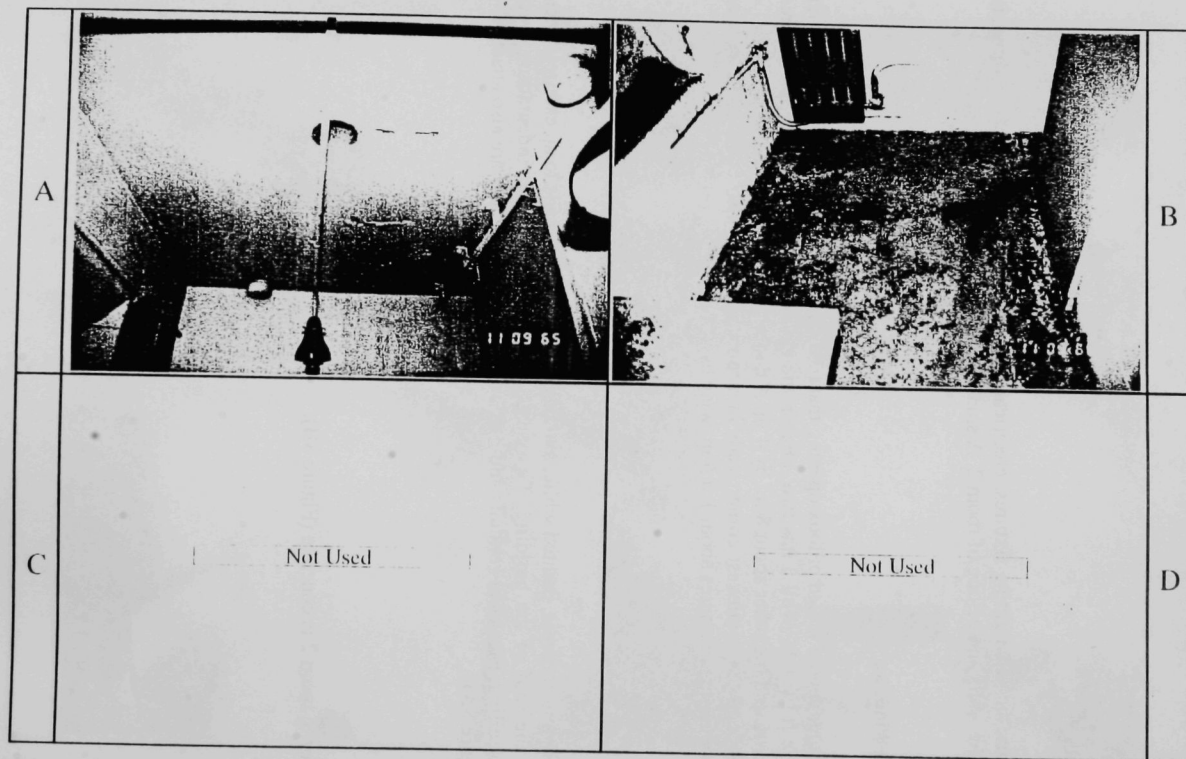
Wall 2 contains the sealed pillbox opening that measures about 5 ft wide by 3 ft high and tapers to about 2 ft by 1 ft. Wall 3 has two interior windows leading to room 4: one measures about 18 in. square and the other about 8 in. by 4 in. A doorway measuring 2 ft 2 in. wide with a sliding metal door in the southwest corner leads into room 3. Wall 4 also contains an interior window into room 1 that measures about 1 ft 5 in. wide by 2 ft high.

4.9.6 Ceiling

The ceiling is concrete, painted white, and has an opening that leads to an exterior sheet-metal vent on the roof of the building. Two sealed pipes and numerous indentations were observed in the ceiling. Electrical conduits and hardware for the sliding door are also attached to the ceiling (Figure 8A).

4.9.7 Floor

The floor in room 2 is concrete (Figure 8B).



A	Ceiling
C	Not Used

Floor	B
Not Used	D

FIGURE 8 Photographs of Room 2 — Ceiling and Floor

4.10 Room 3

4.10.1 Walls

Walls 1 and 3 are constructed of 6-in.-thick cinder blocks; wall 4 is 8-in.-thick cinder blocks. Wall 2 consist of two doorways and the end of the 6-in.-thick cinder block wall dividing rooms 2 and 4. Figure 3 shows assigned wall numbers. Photographs of the interior walls of room 3 are shown in Figure 9.

4.10.2 Finish Materials

The cinder block walls are painted white.

4.10.3 Piping

None.

4.10.4 Equipment

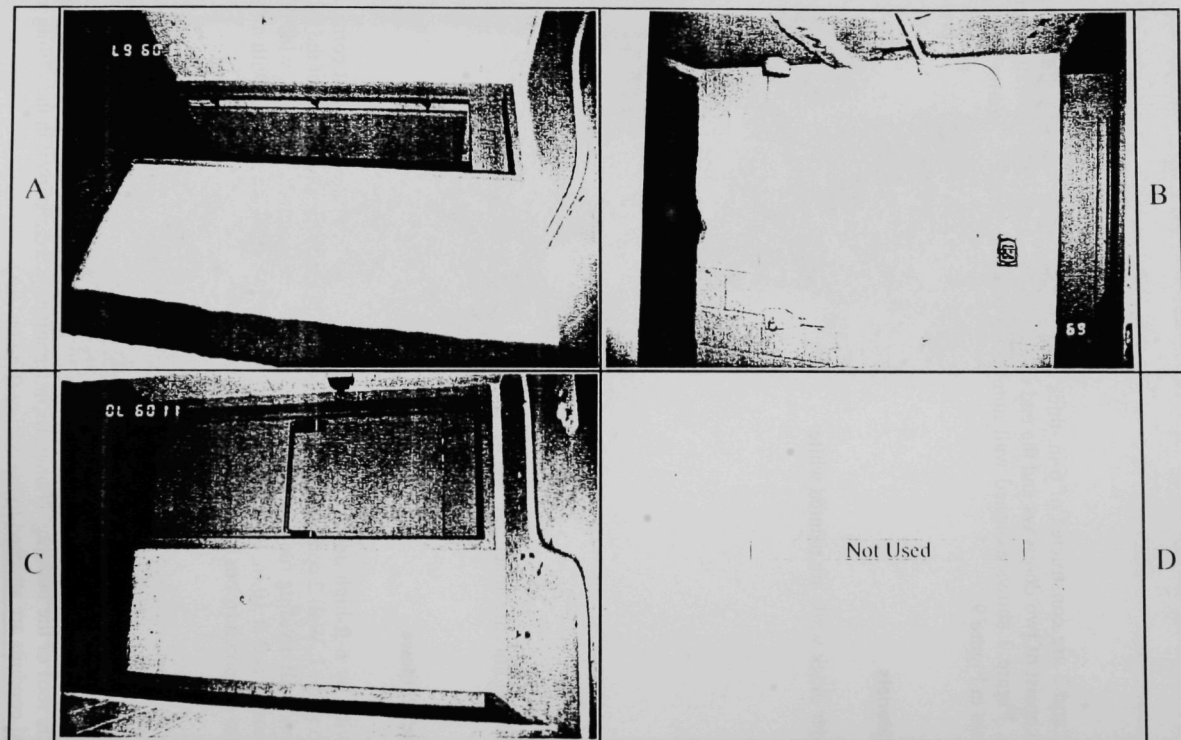
Electrical conduits are attached to the walls and ceiling of room 3.

4.10.5 Doors and Windows

A 2-ft-wide by 6-ft-high doorway, containing a metal door, in the northwest corner of wall 1 leads into room 1. Wall 2 consist of two doorways, with no doors, and the end of the 6-in.-thick cinder block wall dividing rooms 2 and 4. The doorway into room 2 is 2 ft 2 in. wide. The doorway into room 4 is 2 ft 10 in. wide. Wall 4 contains a 2-ft-8-in.-wide doorway with a metal door leading onto the porch (room 6). Room 3 has no windows.

4.10.6 Ceiling

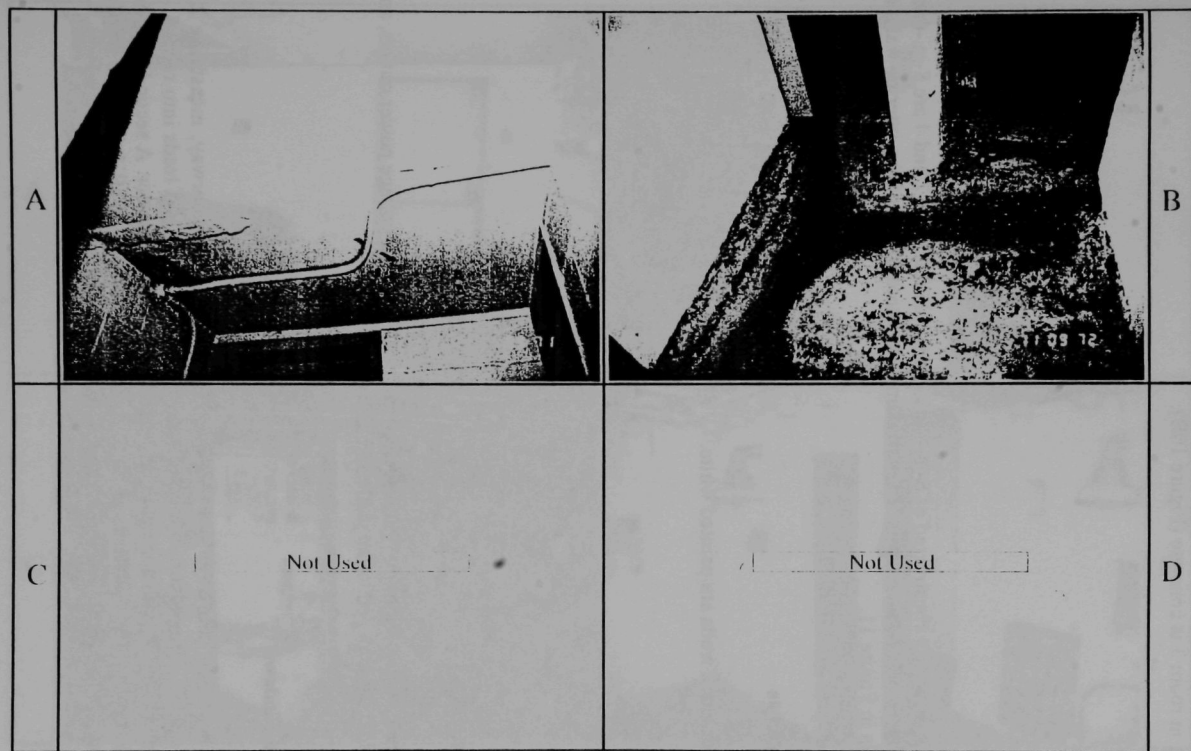
The ceiling is concrete, painted white, and has an opening that leads to an exterior sheet-metal vent on the roof of the building. Numerous indentations were observed in the ceiling and several electrical conduits are attached to the ceiling (Figure 10A).



A	Walls 4, 1
C	Walls 3, 4, 1

Walls 2, 3, 4	B
Not Used	D

FIGURE 9 Photographs of Room 3 — Walls



A	Ceiling
C	Not Used

Floor	B
Not Used	D

FIGURE 10 Photographs of Room 3 — Ceiling and Floor

4.10.7 Floor

The floor in room 3 is concrete (Figure 10B).

4.11 Room 4

4.11.1 Walls

Walls 1, 3, and 5 are constructed of 6-in.-thick cinder blocks; walls 2 and 4 are 8-in.-thick cinder blocks. Figure 3 shows the assigned wall numbers. Photographs of the interior walls of room 4 are shown in Figure 11.

4.11.2 Finish Materials

The cinder block walls are painted white.

4.11.3 Piping

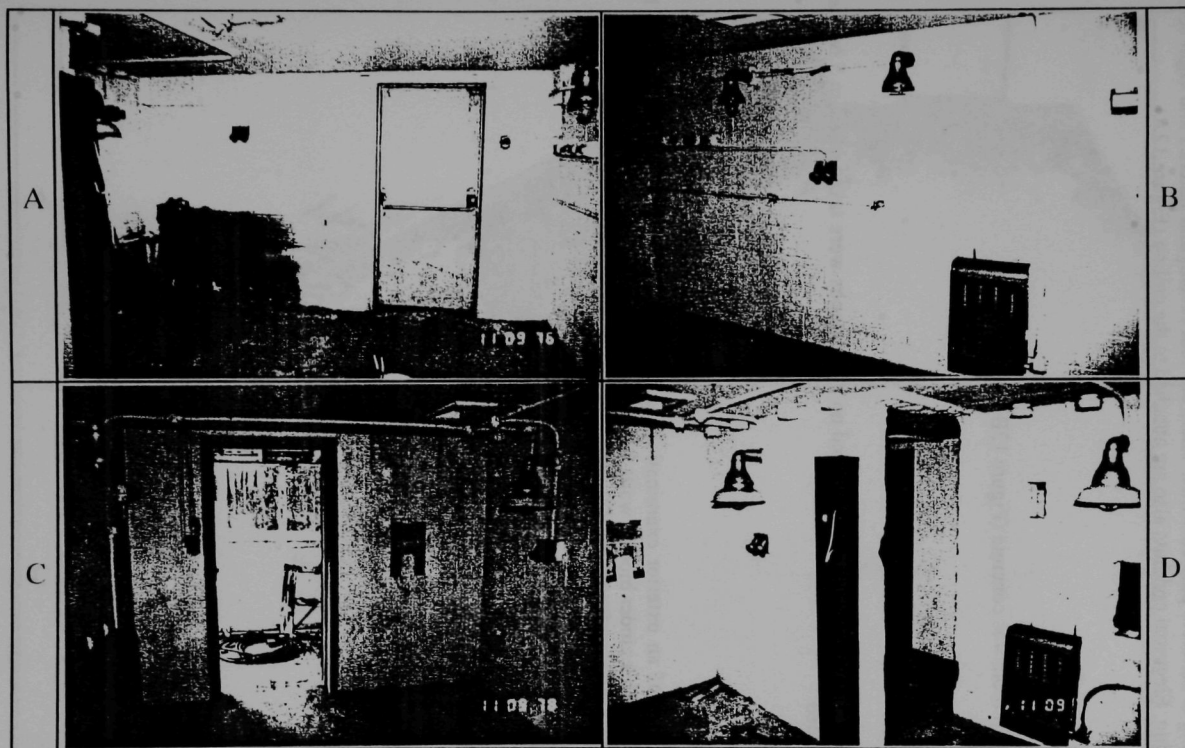
None.

4.11.4 Equipment

Two electric heaters, lighting fixtures, electrical conduits, high-voltage power outlets, and a fire blanket holder are attached to the walls and ceiling of room 4.

4.11.5 Doors and Windows

Room 4 has three doorways and two interior windows. One doorway, measuring 2 ft 10 in. wide and containing no door, is located between walls 1 and 5 and leads into room 3. A 3-ft-wide doorway in wall 2, with a metal door, leads to the building exterior. A second 3-ft-wide doorway in wall 4, with a metal door, leads to the porch (room 6). Wall 2 has two interior windows into room 2: one measures about 18 in. square and the second measures about 8 in. by 4 in.



A	Walls 1, 2, 3
C	Walls 3, 4, 5

Walls 2, 3	B
Walls 4, 5, 1	D

FIGURE 11 Photographs of Room 4 — Walls

4.11.6 Ceiling

The ceiling is concrete painted white. There are four rectangular hatches and eight sealed pipes in the ceiling. Electrical conduits also are attached to the ceiling (Figure 12A).

4.11.7 Floor

The floor in room 4 is concrete (Figure 12B).

4.12 Room 5

No interior inspection was conducted and no photographs were taken of room 5 because this room was sealed.

4.12.1 Walls

On the basis of an exterior examination and measurements, wall 1 is assumed to be constructed of 6-in.-thick cinder blocks; walls 2, 3, and 4 are 8-in.-thick cinder blocks.

4.12.2 Finish Materials

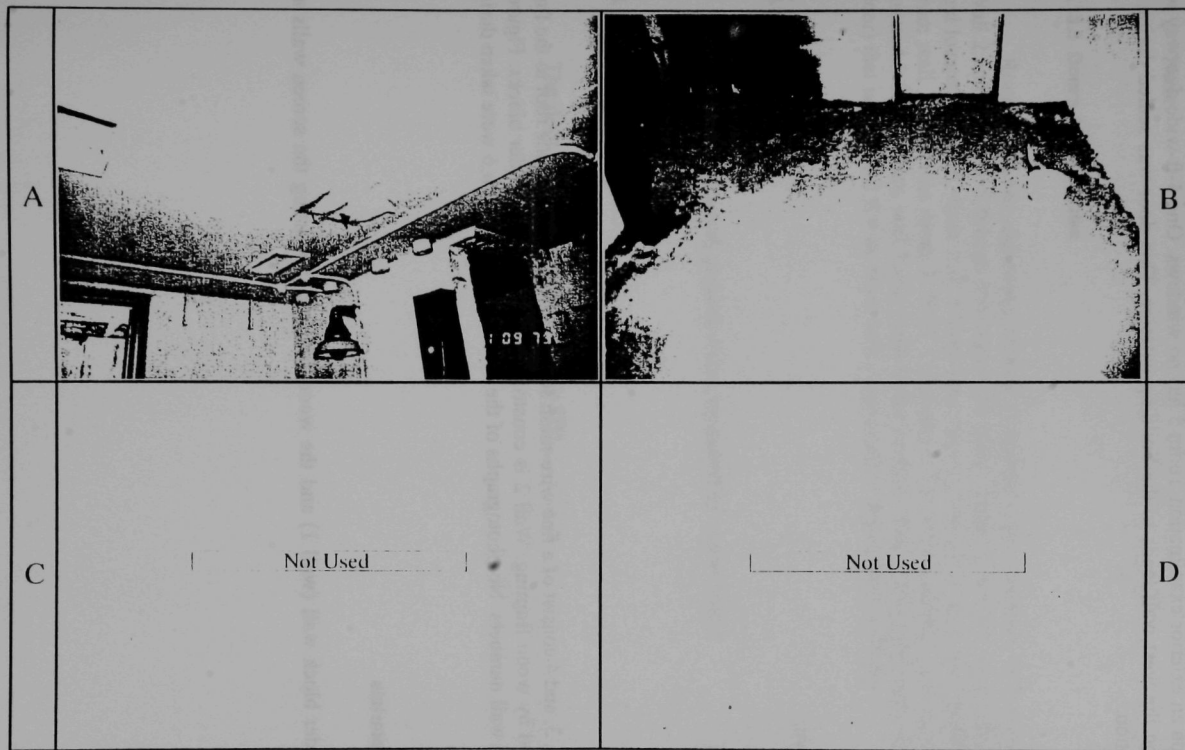
Unknown.

4.12.3 Piping

Unknown.

4.12.4 Equipment

Unknown.



A	Ceiling
C	Not Used

Floor	B
Not Used	D

FIGURE 12 Photographs of Room 4 — Ceiling and Floor

4.12.5 Doors and Windows

Based on an exterior examination, room 5 has no windows. One 4-ft-wide doorway with a metal door on the west wall leads to the building exterior. This door was sealed during the ANL investigation.

4.12.6 Ceiling

Unknown.

4.12.7 Floor

Unknown.

4.13 Room 6

4.13.1 Walls

Walls 1, 3, and 4 consist of a fine wire-mesh screen that extends from the roof to the floor and is supported by wood framing. Wall 2 is constructed of 8-in.-thick cinder blocks. Figure 3 shows assigned wall numbers. No photographs of the interior walls of room 6 were taken during the inspection.

4.13.2 Finish Materials

The cinder block wall (wall 1) and the wood framing supporting the screen walls are painted white.

4.13.3 Piping

None.

4.13.4 Equipment

None.

4.13.5 Doors and Windows

Room 6 has two doorways leading to interior rooms and two doorways to the exterior. Wall 2 contains two 6-ft-high doorways with metal doors; a doorway measuring 2 ft 8 in. wide and located 3 ft 6 in. from wall 1 leads into room 3, and a 3-ft-wide doorway located 2 ft 4 in. from wall 3 leads into room 4. Wall 3 contains a 3-ft-wide doorway with a screen door that is located 2 ft 6 in. from wall 2 and leads to the exterior. Wall 4 has a 3-ft-wide doorway (with no door) that is located 2 ft 6 in. from wall 1 and leads to the building exterior.

4.13.6 Ceiling

The ceiling is wood, painted white, supported by wood rafters.

4.13.7 Floor

The floor in room 6 is wood (Figure 8B).

5 Geophysical Investigation

ANL geophysical staff surveyed the area around Building E3180 during late June and early July 1994. Nonintrusive methods used for the surveys were magnetic gradiometer, total-field magnetics, electrical conductivity (EM-31), induced electromagnetic field (EM-61), and GPR.

Geophysical surveys of the Building E3180 site suggest that large metallic objects may be buried between the building and the southern edge of the survey area (Kings Creek Road), and immediately adjacent to the building on the east, north, and west sides. Elsewhere around the site, buried metallic objects are probably limited in size. GPR data indicate that the ground within 35 ft of the building has been disturbed. GPR data also show a north/south-trending anomaly about 10 ft west of the west side of the building that is apparently caused by a nonmetallic source.

The geophysical surveys suggest the presence of some underground objects near Building E3180, but do not provide conclusive evidence of the sources of the anomalies detected. The interim geophysical report for Building E3180 is provided as Appendix A.

6 Air Quality Investigation

ANL staff collected air quality samples downwind and inside of Building E3180 during November 1994. Analytical results showed no distinguishable difference in the levels of hydrocarbons and chlorinated solvents between the two background samples and the samples taken inside Building E3180. These results indicate that Building E3180 is not a source of volatile organic compound contamination. The air quality monitoring report is provided in Appendix B. Because room 5 could not be investigated, an inspection and monitoring of that room is recommended.

7 Underground Storage Tanks

No information on underground storage tanks associated with Building E3180 is available.

8 Conclusions

On the basis of information collected and reviewed by ANL for Building E3180, it is the authors' judgment that potential undetermined contamination could exist in room 5 of the building. No significant air contamination is associated with the other rooms the building. Results of the geophysical surveys indicate some anomalies near Building E3180 that warrant further investigation and evaluation.

9 References

EAI Corporation, 1989, *Historical Records Search and Site Survey of the Edgewood Area Building — Final Report*, prepared for U.S. Army Chemical Research, Development, and Engineering Center, Aberdeen Proving Ground, Maryland, under contract no. DAAIS-87-D0021.

Nemeth, G., 1989, *RCRA Facility Assessment Report, Edgewood Area, Aberdeen Proving Ground, Maryland*, unnumbered report prepared for Aberdeen Proving Ground, Maryland.

Appendix A:

Interim Progress Report — Environmental Geophysics: Building E3180 Decommissioning, Aberdeen Proving Ground

**Interim Progress Report —
Environmental Geophysics:
Building E3180 Decommissioning,
Aberdeen Proving Ground**

by

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 27711

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Preface

This report is one of a series on environmental geophysical studies around perimeters of buildings in the Edgewood Area of Aberdeen Proving Ground. The series was initiated in 1991 at Building E5032, where techniques were evaluated and a design for the surveys was established. Studies continued in 1992 and 1993, when surveys of Buildings E5190, E5282, E5375, E5440, E5476, E5481, E5485, E5487, E5489, E5974, E5978, and the Building E103 Dump were completed. In 1994, geophysical surveys were completed around Buildings E1489, E2370, E3162, E3163, E3180, E3236, E3613, E3640, E6891, and E7995, and Building E5032 was resurveyed; newer, continuously recording equipment was used in all 1994 surveys. Deeper insight into the magnetic, electrical, and radar imagery characteristics of the Canal Creek and Kings Creek Areas has been gained from the completion of each geophysical survey. Subsequent improvements in survey design and data acquisition, processing, and interpretation have been realized at more recent sites, including Building E3180.

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**Interim Progress Report —
Environmental Geophysics:
Building E3180 Decommissioning,
Aberdeen Proving Ground**

by

M.D. Thompson, C.R. Daudt, L.D. McGinnis, S.F. Miller,
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Abstract

The immediate vicinity of Building E3180, a potentially contaminated site in the Edgewood Area of Aberdeen Proving Ground, was examined by using several noninvasive geophysical methods, including total-field magnetic, electrical conductivity, time-domain electrical induction, and ground-penetrating-radar (GPR) techniques. Several point-source anomalies were observed in two or more data sets; the anomalies generally had radii of 5 ft or less. Several data sets indicated strong anomalies adjacent to the building, which might be explained, in part, by buried metallic objects. GPR data were useful in delineating the extent of disturbed sediments. A linear trend in GPR reflection data at one location suggests the presence of a buried tile or similar nonmetallic linear feature.

1 Introduction

Aberdeen Proving Ground (APG), in the state of Maryland, is managing a comprehensive Installation Restoration Program involving more than 360 solid-waste-managing units contained within 13 study areas. The Edgewood Area of Aberdeen Proving Ground appears on the National Priority List under the Comprehensive Environmental Response, Compensation, and Liability Act. Therefore, APG has entered into an Interagency Agreement with the U.S. Environmental Protection Agency to address the listed areas.

The Kings Creek portion of the Edgewood Area (Figure 1) requires a Source Definition Study because the potential exists for release of volatile organic compounds into the aquifer system. A report prepared by the EAI Corporation included a list of 29 potentially contaminated buildings in the Edgewood Area (1989). The buildings have been abandoned and operations have ceased, but processing equipment, incinerators, sumps, drains, ventilation systems, and underground storage tanks remain. These appurtenances may contain liquid, solid, or vapor contaminants of unknown nature. Sixteen of the buildings contain known contaminants, nine buildings contain unknown contaminants, and four of the buildings are potentially clean. The EAI report recommended that a sampling and monitoring program be established to verify contamination levels in and around each building. Most of the effort thus far has been in the western Canal Creek Area.

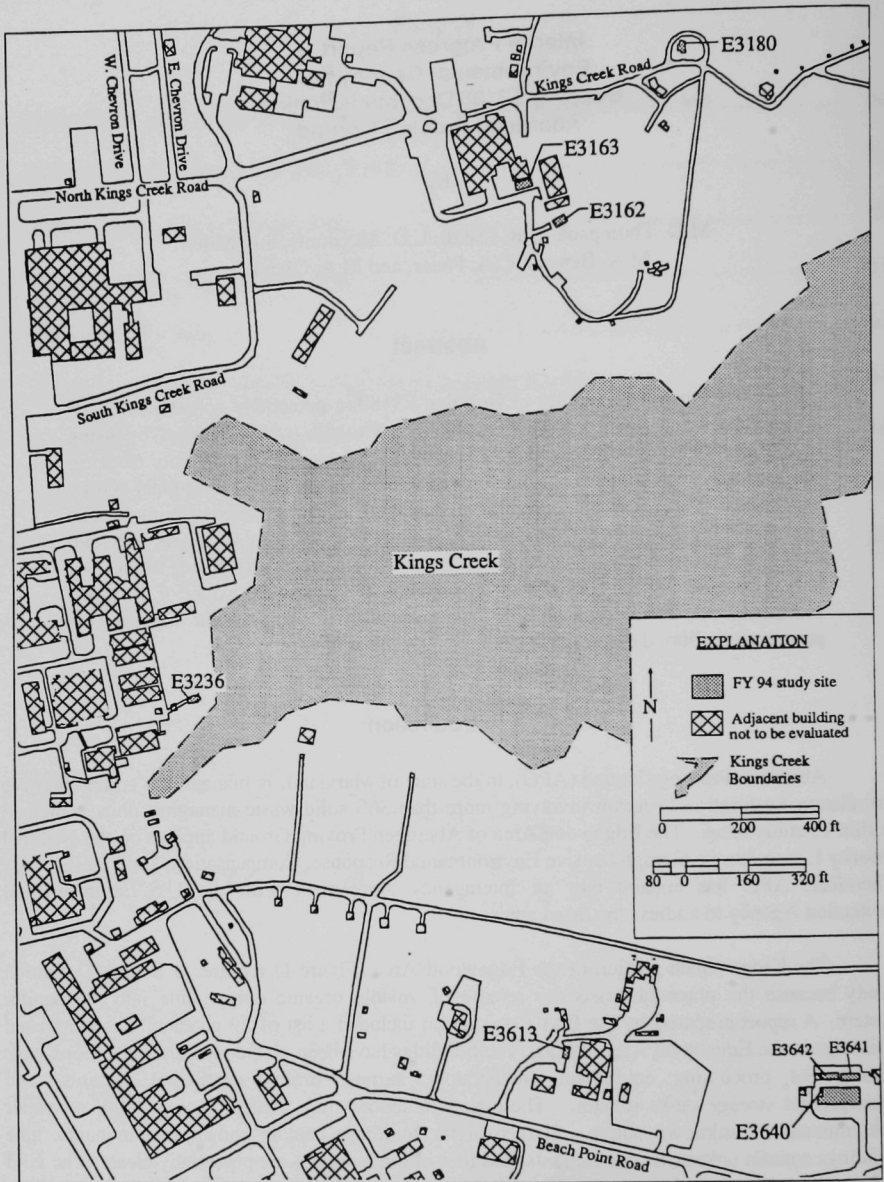


FIGURE 1 General Site Map of the Kings Creek Area, Aberdeen Proving Ground, Md.

Six of the potentially contaminated buildings, including Building E3180, are in the drainage basin of Kings Creek. Aberdeen Proving Ground is proceeding with a program to decommission the buildings, which will eliminate the actual or potential release of contaminants into the environment. Argonne National Laboratory (ANL) has been assigned the task of developing a plan and scope of work for the proposed decommissioning. Argonne has determined that the first step in this decommissioning process, where it is technically feasible, should be a noninvasive geophysical survey around building exteriors.

1.1 History of Building E3180

Building E3180 is located at the eastern end of Kings Creek Road (Figure 1). According to the building records examined by EAI Corporation (1989), the building was constructed in 1944 and served as a Japanese pillbox model. The building was not used between 1957 and 1965. From 1965 to the early 1970s, it was operated as a flame and incendiaries laboratory, and from the early 1970s to 1988, it was used as a machine (metal) shop. Activities at the building ceased after 1988.

The building is constructed on a concrete floor measuring 14 ft \times 32 ft, and two additions have been built, measuring 3 ft \times 7 ft and 4 ft \times 7 ft. The walls are composed of 8-in. concrete blocks, and the roof is made of concrete and asphalt. No drainage systems are apparent, and an open (squirrel-cage) exhaust system is the only ventilation. Appurtenances associated with the building are limited to a metal duct on the north face, and a sidewalk to the south (see Figure 2).

Hazardous materials used at the building during its history include the following:

1965-Early 1970s

- Plasticized white phosphorus
- White phosphorus
- Eutectic white phosphorus
- Triethyl aluminum
- Magnesium
- Napalm
- Nonagent thickener
- Red phosphorus
- Thermite

Early 1970s-1988

- Petroleum, oil, lubricants
- Other (unknown) solvents.

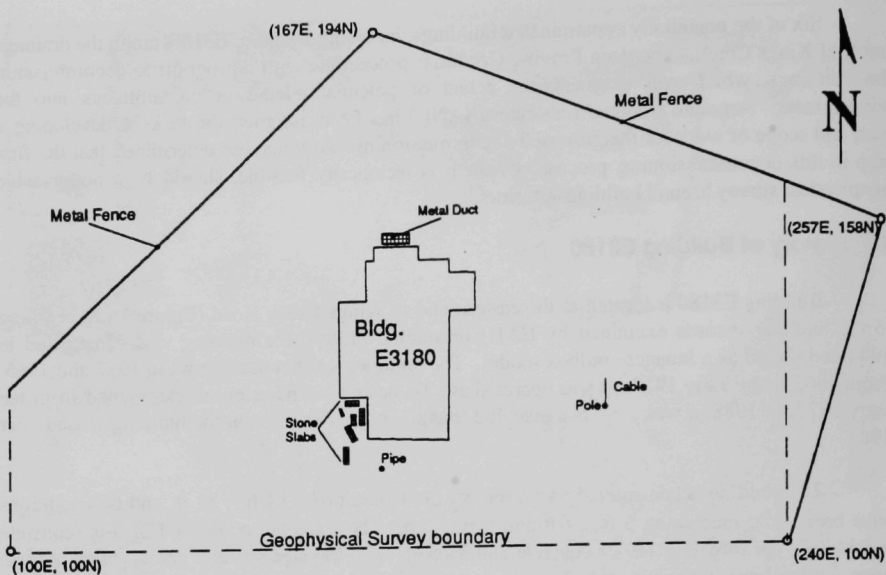


FIGURE 2 Detailed Location Map of Building E3180

As a result of personal interviews conducted by the EAI Corporation (1989), it was concluded that all incendiary material was consumed during laboratory operations. Since no written documentation exists, the building was categorized as having potentially unknown contamination.

1.2 Site Reconnaissance

A geophysics program was initiated in conjunction with decommissioning Building E3180 that was based upon similar programs conducted by ANL personnel at APG since 1991 (McGinnis and Miller 1991; L.D. McGinnis et al. 1992a,b, 1994; M.G. McGinnis et al. 1992a,b; Miller et al. 1992a,b; Thompson et al. 1992a,b, 1994; Benson et al. 1995; Daudt et al. 1995). The initial evaluation was enhanced by a November 1991 site visit and by inspection of aerial photos available to Argonne personnel. The building is located on level terrain adjacent to a marsh that borders the western margin of Kings Creek. The site is accessible from the west and south sides and is grass-covered around the perimeter of the building. A metal chain-link fence borders the site on the northwest, north, and east sides (Figure 2).

In addition to surface conditions at the site, subsurface characteristics were considered in planning the geophysical survey. Surficial sediments consist of estuarine sands, silts, and clays that are nonmagnetic and have electrical properties that vary both horizontally and vertically due to natural conditions or excavation and building effects. Such multiple sources as iron-rich

magnetized objects, nonmagnetic objects, and subsurface channels containing contaminants may be present in the subsurface.

1.3 Geology and Physiographic Setting

The Kings Creek area is contained in topographically low and flat terrain of the Coastal Plain physiographic province, where alluvial and estuarine sands, silts, and clays underlay the region. A thin veneer of sediments of the Talbot Formation of Pleistocene age overlies unconsolidated sediments of the Potomac Group of Cretaceous age (Oliveros and Gernhardt 1989).

Lithologies at the site were determined from the four wells (sites #8, #104, #117, and #136) located in the vicinity of Building E3180. Of these, only well #8 had lithologic samples for the upper 30-40 ft of sediment. The relatively shallow depth range is critical to the geophysical interpretation because the penetration depth for the geophysical techniques used at Building E3180 does not generally exceed 40 ft. Borehole #8 was drilled approximately 1,100 ft west of Building E3180. The descriptive log for borehole #8, given in Table 1, was part of a hydrogeologic study of the Canal Creek Area performed by the U.S. Geological Survey (Oliveros and Gernhardt 1989).

Facies represented include a 3-ft layer of silty soil, followed by a clay zone with thin silt and sand lenses. A thick layer of sand starts at 54 ft in depth. The upper 30 ft of the sedimentary section consists primarily of clay units. Inspection of the ground surface around Building E3180 indicates that some excavation and backfilling must have occurred during construction; thus, the upper 5 ft of material is most likely construction fill.

1.4 Surveys

Geophysical data were acquired during two days of field operations during late June and early July 1994. On-site personal computers, interactive software, and field equipment designed specifically for APG building studies were used to expedite data acquisition and processing. After an initial scan with a magnetic gradiometer, surveys were conducted to measure total-field magnetics, electrical conductivity, induced EMF, and ground-penetrating-radar (GPR) profiles.

1.5 Survey Grid and Locations of Observations

Prior to geophysical data acquisition, the limits of a polygon-shaped survey area surrounding the building were established by marking the corners with wooden stakes (see Figure 2). A metal chain-link fence forms the northwestern and northern borders of the survey area. The y-direction was designated as parallel to the length of the building; the x-direction was perpendicular to the length of Building E3180, along the longest side of the survey area. The longest dimensions of the polygon-shaped area were 140 ft along the x-direction and 94 ft along the y-direction.

Throughout this report, grid coordinates of specific locations shown in Figure 2 and in later figures are specified as (x, y), where x and y refer to approximately easterly and northerly

TABLE 1 Lithologic Log of Well at Site No. 8

Description ^a	Depth (ft)	Thickness (ft)
Silty soil	3.0	3.0
Clay, red, yellow and gray mottled, plastic, dense	19.0	16.0
Clay, red, plastic, dense; with irregular white, silty zones	40.1	21.1
Clay, gray, friable, micaceous; mixed with red clay as above	42.7	2.6
Clay, red, plastic, dense; with irregular, white silty zones and an olive green, mineralized front at the contacts	48.4	5.7
Sand, silty, light gray, poorly sorted, micaceous	52.5	4.1
Clay, red, plastic, dense; with irregular white zones and green mineralization as above	54.0	1.5
Sand, gray, well-sorted (fU-mL); with alternating lenses of dark gray, plastic clay	64.0	10.0
Sand, gray to tan, well-sorted (mU)	66.7	2.7
Sand, silty, gray, lignitic	67.1	0.4
Sand, gray, well-sorted (mL)	69.0	1.9
Sand, silty, wet, brown; with red-black concretions	71.4	2.4
Sand, clayey, white, (fU); with yellow and lavender laminae	72.0	0.6
Sand, silty, multicolored, micaceous	74.7	2.7
Sand, brown, clean, well-sorted (mU); with multicolored laminae and gravel (1-4 in.)	89.0	14.3
No sample	168.4	79.4
Sand, gray (mL) clean	168.7	0.3
Clay, gray and tan mottled, plastic, dense, micaceous	170.8	2.0
No sample	188.1	17.4
Clay, sandy, dark gray, lignitic	190.1	2.0
No sample	199.1	9.0
Clay, gray, micaceous, lignitic; with some floating gravel up to 0.5 in.	199.8	0.7

^a Codes enclosed in brackets at selected horizons refer to color designations as specified in the *Munsell Soil Color Charts* (1975).

Source: Oliveros and Gernhardt (1989).

directions, respectively. Relative coordinate values are in feet. Grid coordinate values of (100, 100) were assigned to the southwest corner of the survey area. The geophysical profiles that are presented in this report were traversed in both x and y directions, generally with a profile spacing of 5 ft.

2.4 Time-Domain MIP-2 Profiles

The MIP-2 system was used to collect time-domain magnetic induction profiles. The system consists of a transmitter coil and a receiver coil. The transmitter coil is connected to a power source and the receiver coil is connected to a measuring device. The transmitter coil is placed on the ground and the receiver coil is placed at a distance from the transmitter coil. The receiver coil is connected to a measuring device that measures the induced magnetic field. The measuring device is connected to a computer that stores the data and generates the profiles.

The MIP-2 system was used to collect time-domain magnetic induction profiles. The system consists of a transmitter coil and a receiver coil. The transmitter coil is connected to a power source and the receiver coil is connected to a measuring device. The transmitter coil is placed on the ground and the receiver coil is placed at a distance from the transmitter coil. The receiver coil is connected to a measuring device that measures the induced magnetic field. The measuring device is connected to a computer that stores the data and generates the profiles.

Data were collected at a rate of 100 samples per second. The data were stored in a file and the profiles were generated from the data. The profiles were generated by averaging the data over a 10 ft interval. The profiles were then plotted on a graph. The graph shows the magnetic field strength in millitesla (mT) versus distance in feet. The profiles were then used to generate a map of the magnetic field strength in the survey area.

2 Instrumentation

2.1 Magnetic Gradiometer and Cable Locator

The Schonstedt MAC-51B magnetic gradiometer and cable locator is a dual-mode instrument designed for detecting shallow-buried iron and steel objects and tracing underground cables and pipes. The system consists of a transmitter and a dual-function receiver designed to detect anomalous magnetic gradients. The MAC-51B is an audio device used only for rapid detection of magnetic materials for further analysis with complementary instrumentation.

Maps or models are not constructed from observations made with this instrument because it is not a calibrated system and it does not have digital data recording. Anomalies are identified by changes in sound amplitude and frequency and are marked on the ground surface prior to the initiation of other surveys. If anomalies detected with the MAC-51B cannot be verified with the magnetometer (see Section 2.2), the anomaly is assumed to be insignificant.

Application of the MAC-51B in its receiver mode is the first geophysical operation following establishment of survey limits. A qualitative description of the site with 100 percent ground coverage is achieved by using the gradiometer, whereas the results obtained with the other techniques, although more quantitative, are spatially limited to single-point survey-grid observations or to continuous readings along spaced profiles.

2.2 Total-Field Magnetism Meter G-822L

Magnetometer surveys were conducted to identify such ferromagnetic objects as tanks, drums, drain pipes, water lines, and small ferrous objects. An EG&G Geometrics G-822L cesium-vapor magnetometer was used to measure the total magnetic field around Building E3180. The G-822L was operated in a continuously recording mode and acquired magnetic measurements at intervals of approximately 0.3 ft.

Because of the dipolar field, a magnetic anomaly due to a source having a simple physical shape exhibits a characteristic signature consisting of a positive magnetic peak and at least one negative magnetic trough. If a symmetrically shaped body of iron-rich waste is buried in the northern hemisphere and becomes magnetized in the earth's field, a large positive anomaly with a weak negative offset to the north will occur. The horizontal distance between the paired peak and trough is proportional to the depth of burial, the size, and the shape of the source, whereas the amplitude of the anomaly is inversely proportional to the depth of burial. Metallic debris at, or just below, the ground surface produces strong, closely spaced, magnetic peaks and troughs, separated by high-gradient areas.

When using the G-822L magnetometer, the sign of magnetic anomalies must be viewed with extreme caution, because in a region of high gradients, the magnetometer becomes untuned and provides zero readings. Contouring software for the G-822L has been designed to bridge the zero gap with mean values taken from the last readable data along the profile. Thus, because of the bipolarity of magnetic anomalies and the variability of gradients, it is possible for an isolated anomaly or a lineament to change from a positive to a negative feature along the trend. For the

purpose of this study, the polarity of the anomaly is unimportant. The absolute strength of the magnetic anomaly and whether the anomaly appears as a "point" source or a linear feature are more important to the geophysical interpretation.

2.3 Conductivity Meter EM-31

Mean conductivities were obtained with the Geonics EM-31, an electromagnetic (EM) induction instrument that measures mean terrain conductivity to depths of approximately 20 ft. The induction coil of the EM-31 transmits an EM field into the ground, and a receiver measures the secondary magnetic field caused by the low-intensity eddy currents induced in the subsurface. The field strength of the secondary magnetic currents are almost linearly proportional to the electrical conductivity of the surrounding sediment.

Data were collected at 0.5-s intervals with the EM-31 and were stored on the OMNI 720 data logger, which can log quad-phase electrical conductivity data and in-phase inductive data for metals simultaneously, as well as store survey geometry. Data for this survey were recorded in quad-phase only. Internal software permits downloading directly into an on-site computer. Conductivity contouring is incorporated into the field acquisition procedure so that daily map outputs can be available for observation and interpretation. EM methods have been used extensively in the Edgewood Area at Beach Point, J-Field, and various buildings surveyed by ANL staff.

2.4 Time-Domain Millivolt Meter EM-61

Field data were obtained in millivolts with a Geonics EM-61, a portable, time-domain, electrical induction instrument that transmits an electrical pulse into the ground and measures secondary EMFs caused by metallic objects beneath the instrument. As a consequence of its coil arrangement, the EM-61 is relatively insensitive to surface interference but more sensitive to deeply buried metallic targets. Data are recorded on three channels, including the response from an upper coil, a lower coil, and a coil difference.

The lower coil, because of its spatial positioning, responds to signal from all depths within the instrument range. According to the manufacturer's claims, the lower coil can detect an anomaly of 2 mV caused by a 55-gal metal drum buried at a depth of about 9 ft. Inspection of the data sets acquired at Building E3180 and other APG sites surveyed by ANL personnel indicate that the measurements obtained from the lower coil are sufficient to identify buried metallic sources within the gridded area.

Data were collected at a rate of three readings per second and were stored on the OMNI 720 data logger. Internal software permits downloading directly into an on-site computer. Contouring of data in millivolts is incorporated into the field acquisition procedure so that daily map outputs can be available for observation and interpretation.

2.5 Ground-Penetrating-Radar System

Ground-penetrating-radar surveying and data processing were accomplished using a Geophysical Survey Systems, Inc., SIR-3 radar system and Radan III software (Galinovsky and Levin 1990). A 300-MHz monostatic-transceiver-antenna system was tethered to the SIR-3 with a 100-ft cable. Data were recorded on a digital audio tape to permit playback. The SIR-3 control unit/graphic recorder was located in the transport vehicle. A computer was located in a field office, so that the radar operator could download, check data quality, and do preliminary processing after a day's run.

Wave-velocity characteristics of near-surface materials were derived from known positions of buried objects. Internal calibration was run at least twice each day to ensure that the graphic record of the range setting was consistent. Studies conducted during the 1991, 1992, and 1993 field seasons indicate GPR travel times of 7-9 ns/ft for near-surface sediment (Geophysical Survey Systems, Inc. 1987). However, conditions vary with the heterogeneity of the subsurface.

Ground-penetrating radar is the best method available to determine depth and geometry of objects buried near the surface. The weakness of the method is its limited depth of exploration due to wave-propagating constraints imposed by the electrical properties of soils. The recorded range of GPR data at Building E3180 was 70 ns, which corresponds to an approximate depth range of 0-10 ft below the ground surface. The actual sensitivity of the GPR recording system is probably less than half of the 0-10 ft depth range. Depths are calculated from known travel times through earth materials found at APG.

3 Geophysical Measurements and Surveys

Color-contour maps of the total magnetic field, terrain conductivity, and time-domain EMF data presented in this report were constructed from the survey data by using software developed at ANL (Thompson 1994). The data set comprises 8,770 magnetics measurements; 2,360 conductivity measurements; and 2,333 EMF measurements. Profile plots of selected GPR transects are also presented and represent a data set comprising 3,642 linear feet of profiling.

On each color-contour plot, the following coloring convention is maintained: Building E3180 is depicted as a solid white polygon and cement structures or pads as patterned rectangles. Where possible, a descriptive name was also overlain onto the color diagram.

Gridding of data was accomplished with a minimum curvature technique using one of two computer programs: MINC, produced by the U.S. Geological Survey (Cordell et al. 1992); and SURFER, produced by Golden Software, Inc. (1991). Documentation supplied with the MINC program suggests that grid intervals from one-half to one-fifth of the profile spacing will yield adequate gridding results for data acquired along profiles. A grid interval of 1.0 ft was used for each set of grid data and represents a grid interval of one-fifth of the profile spacing (5 ft).

3.1 Total-Field Magnetism

The magnetic field measured around Building E3180 is shown in Figure 3. Also depicted are the magnetometer profiles, which were run in both x- and y-directions. The magnetic field around Building E3180 is dominated by anomalies caused by the steel fence and the building. Examination of Figure 3 shows that magnetic data within 7 ft of the steel fence cannot be used.

Several other magnetic anomalies are also attributed to features visible at the surface. A 10-ft diameter magnetic high located immediately north of Building E3180 is probably caused by the adjacent metal duct (see Figure 2). The magnetic high/low pair, located at grid coordinates (210, 134), is due to the guy-wire and anchor stake that support the utility pole to the east of the building.

Low magnetic anomalies located adjacent to the building are generally attributed to magnetic material associated with the building structure. The anomaly on the eastern edge of the building, which extends outward nearly 10 ft, may in part be attributed to buried metallic material.

An 8-ft wide magnetic low extends from the southwest corner of Building E3180 and exits the survey area to the south. The northern half of this anomaly is spatially located over a cluster of stone/cement slabs that presumably once formed a sidewalk. The southern half of the anomaly may be caused in part by a continuation of this walkway. However, the anomaly is also adjacent to a vertical pipe that is located at grid coordinates (165, 115) (shown in Figure 2); the anomaly may be caused by a buried metallic object associated with the pipe.

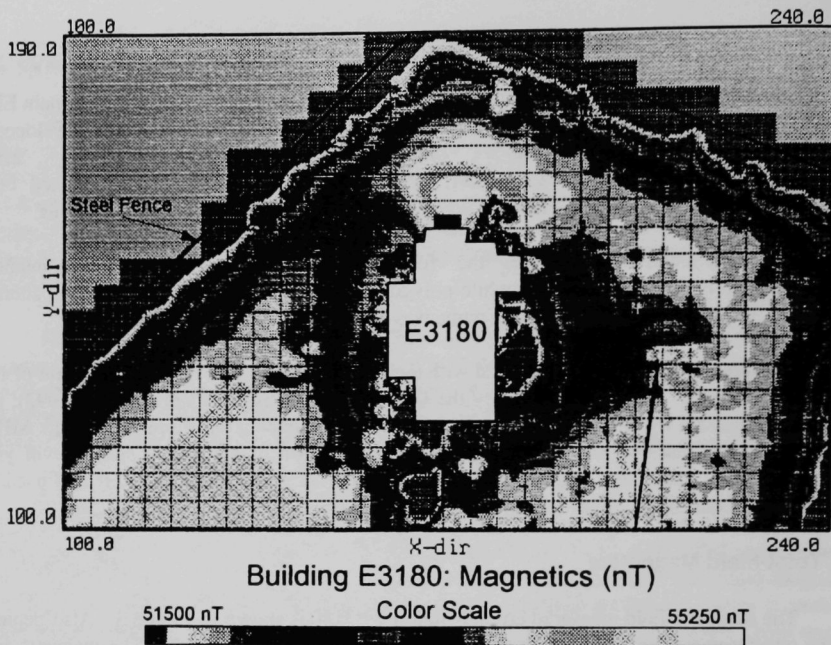


FIGURE 3 Total Magnetic Field Anomaly Map

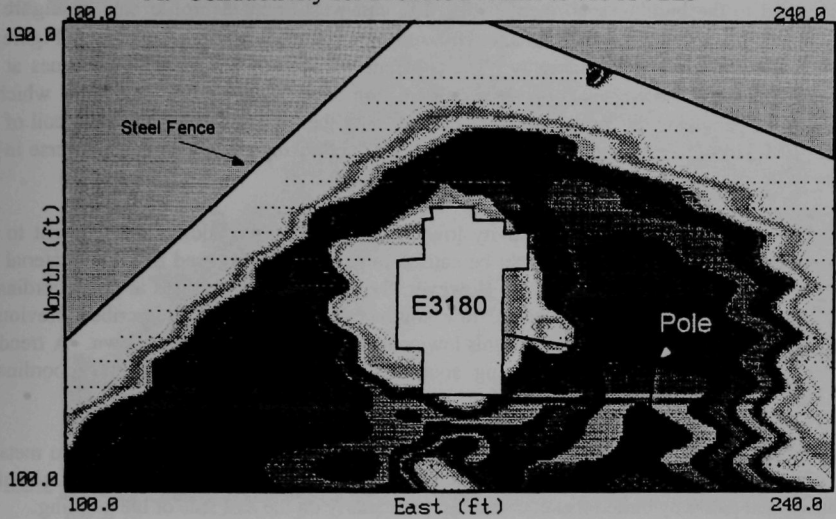
An isolated magnetic high with a diameter of 4 ft is located 5 ft east of the walkway and of the pipe at grid coordinates (170, 112). This anomaly, which has no apparent surface expression, coincides with a relatively large EMF anomaly. The source of the anomaly is unknown.

Other isolated magnetic anomalies are not associated with any readily observable surface expressions. Sources for anomalies located at grid coordinates (150, 110); (140, 130); (145, 135); (205, 150); and (180, 180) are most probably buried metallic debris.

3.2 Terrain Conductivity Measurements

Figure 4 shows the mean electrical conductivity for the upper 20 ft of sediment around Building E3180. Figure 4A shows a color map derived from profiles conducted parallel to the x-axis, while Figure 4B shows a color map derived from profiles conducted parallel to the y-axis. The data were contoured using a contour interval of 2 mS/m. As with the magnetic anomaly map, the effects of the steel fence dominate much of the figure, and conductivity data acquired within 15 ft of the fence line are not usable.

A: Conductivity for Profiles Parallel to the X-Axis



B: Conductivity for Profiles Parallel to the Y-Axis

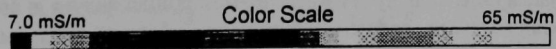
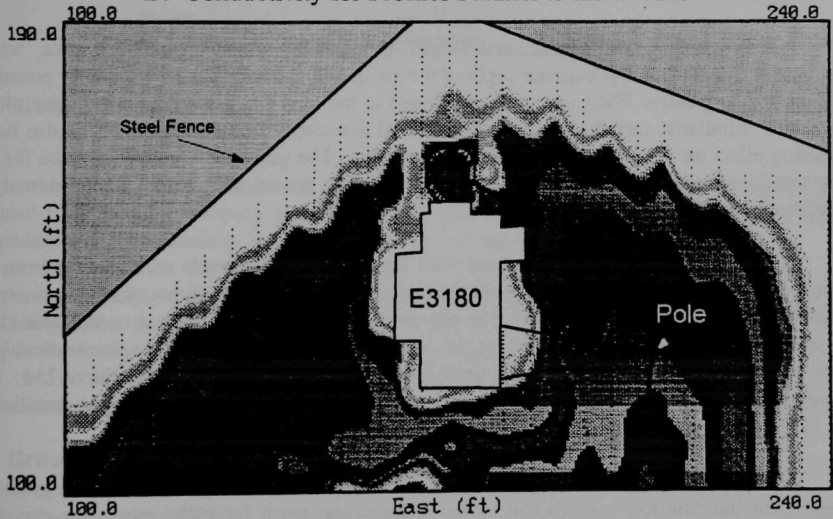


FIGURE 4 Terrain Conductivity Anomaly Map

A conductivity low centered at grid coordinates (170, 162) is probably due to the metal duct attached to the building's northern wall. The east-west-oriented profile data in Figure 4A along $y = 160$ ft do not show such an anomaly; only the perpendicular profile data in Figure 4B along $x = 170$ ft show the low anomaly. The apparent discrepancy of conductivity values at the intersection of the two traverses is due to the orientation of the Geonics EM-31 boom, which is always carried parallel to the direction of the profile during the survey. The transmitter coil of the Geonics EM-31 boom came in proximity to the metal duct during the north-south traverse in the vicinity of the two perpendicular profiles.

The complex pattern of conductivity lows southwest of the building and adjacent to the southern border of the survey area might be caused in part by gravels used as grade material for the adjacent access road to the building. However, the strongest low, located at grid coordinates (175, 100), overlaps the strong magnetic low southwest of the building described previously (Section 3.1; see Figure 3). The cause of this low conductivity anomaly is not known. A trend of positive conductivity anomalies extending southwest from the building to grid coordinates (150, 105) may be related to the same source.

High conductivities immediately adjacent to the building are primarily attributed to metallic material associated with the building structure. Like the magnetic data, however, the anomalies may be caused partly by buried metallic sources, particularly on the east side of the building.

3.3 Induced-EMF Measurements

A color-contour map constructed from the Geonics EM-61 lower coil data, which represents all signal to an approximate depth of 9 ft, is shown in Figure 5. As with other potential-field data, strong positive EMF anomalies attributed to the steel fence dominate the edges of the survey area. Similarly, metallic construction material associated with Building E3180 also had a dominating effect on data collected close to the building. The guy-wire and anchor stake for the adjacent utility pole at grid coordinates (210, 130) probably caused the positive EMF anomaly at that location, just as it did for magnetic data.

The strong EMF anomaly associated with Building E3180 extends relatively far from the building, both from the south wall and from the southwest corner. In both locations, the anomaly extends more than 10 ft from the building in proximity to the EMF anomaly at coordinates (162, 102) (discussed below). The anomaly at the southwest corner is adjacent to the vertical pipe located at grid coordinates (165, 115) (Figure 2) and is coincident with a strong magnetic low. The anomaly at the south wall is coincident with the isolated magnetic high located at grid coordinates (170, 112). The sources of the anomalies are unknown.

The low anomaly immediately north of the building is a gridding artifact. Steep gradients caused by the building to the south and by the fence to the north force the minimum curvature algorithm to calculate a false anomaly. Neither east-west profiles along $y = 160$ ft nor the profiles along $y = 180$ ft exhibit a strong conductivity low.

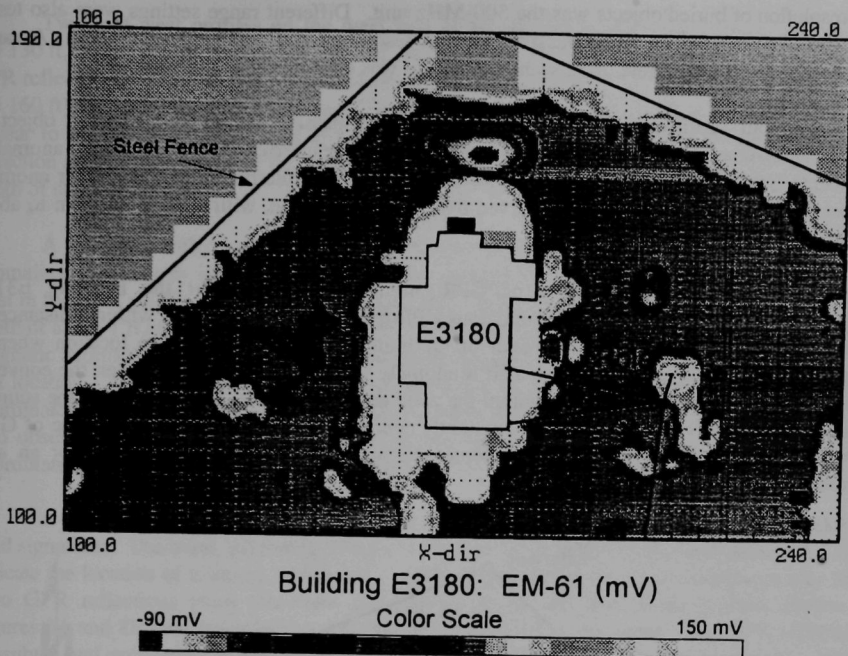


FIGURE 5 EMF Anomaly Map

Along the southern border of the survey area, south of Building E3180, a north-south-oriented EMF positive anomaly was observed at grid coordinates (162, 102). The anomaly is coincident with a conductivity low and overlaps a magnetic low.

A relatively strong positive EMF anomaly was observed at grid coordinates (130, 125), coinciding with a weak magnetic anomaly. Isolated positive EMF anomalies were also observed at grid coordinates (102, 108); (150, 110); (145, 137); (140, 132); (203, 115); (213, 120); and (205, 145). Many of these anomalies are coincident with magnetic anomalies. No surface expressions were observed, and these anomalies are interpreted to be due to buried metal debris.

3.4 Ground-Penetrating-Radar Measurements

Coordinates of GPR lines from the Building E3180 survey are shown in the Attachment. The lines are numbered in sequence, along with the beginning and ending positions relative to the grid survey. Prior to running the production lines for the survey, replicate runs were made over the same line to determine which of the three transceivers, the 80-, 300-, or 500-MHz antenna, was best suited to study the terrain surrounding the site. The transceiver providing the best penetration

and resolution of buried objects was the 300-MHz unit. Different range settings were also tested over the same transect to determine the optimum resolution and depth of penetration. A range setting of 70 ns at a scan rate of 32 scans per second was used for the entire survey.

Without verification by another technique or by passing the antenna over an object of known depth, characteristics of radar anomalies may only be inferred. However, where anomalies are also seen with magnetic or resistivity profiling, a diagnostic interpretation of the radar anomaly is possible. Good penetration was observed over most of the site, with resolution down to about 8 ft below the ground surface.

Figure 6 shows a summary of GPR anomalies observed for the Building E3180 geophysical survey area. A zone of anomalous GPR reflections was observed within a distance of about 35 ft around much of the perimeter of the building. Generally, at each location where a potential-field anomaly was observed, a GPR anomaly was also observed. However, the converse was not always the case, particularly within the zone described above, suggesting that the sources of many of the GPR reflections are predominantly nonmetallic in composition. The zone of GPR reflections around the building probably represents an area of disturbed sediments or an area covered with sedimentary fill material.

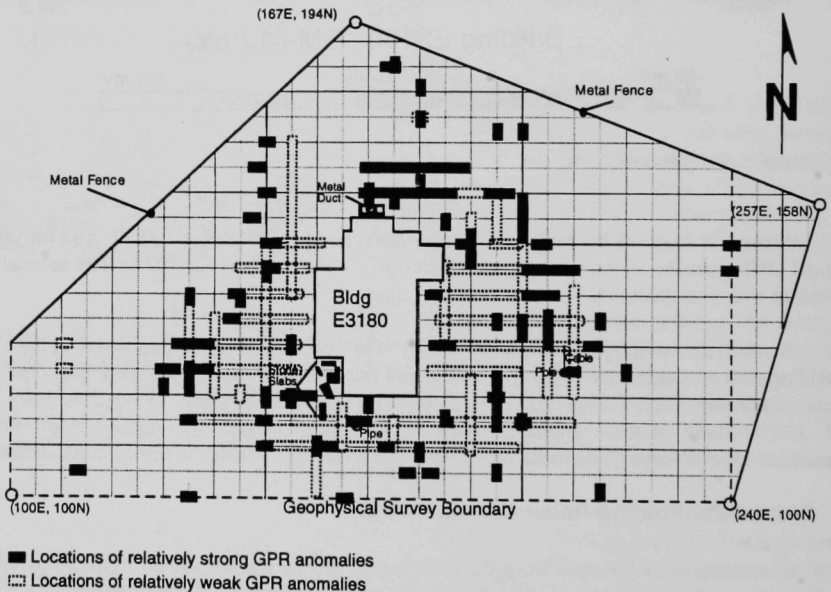


FIGURE 6 Locations of Anomalous GPR Reflectors for Building E3180

Two east-west profiles on the west side of building, corresponding to $y = 125$ ft and $y = 130$ ft, are shown in Figures 7A and 7B, respectively. Both profiles show a series of strong GPR reflections within the zone described above, located between $x = 140$ ft and the building (at $x = 160$ ft). They are typical of adjacent GPR profiles on the west side. The strongest reflectors appear to be within a depth range of 1.0-2.5 ft. Both profiles also show an apparent dipping reflection at the leading edge of the anomaly. The reflection is observed at about $x = 138$ ft, at a depth of about 6 ft.

A few GPR reflections on the west side of the building do coincide with potential-field anomalies. A relatively isolated, but nevertheless strong, GPR reflection is also observed further west in the GPR profile for $y = 125$ ft (Figure 7A). The reflection, centered at $x = 130$ ft, has a depth of about 1 ft and is coincident with a strong EMF anomaly (Figure 5) and a relatively high magnetic anomaly (Figure 3). The source of the anomalies is probably a buried metallic object at that location. A GPR reflection (Figure 6) corresponds to the magnetic anomaly located at grid coordinates (150,110) and also probably indicates a buried metallic object. Magnetic anomalies are also observed within the zone of GPR reflections near the west side of the building at grid coordinates (140,130) and (145,135) (Figure 6).

A subtle trend of GPR reflections was observed that did not have corresponding potential-field signatures. The trend, extending along $x = 150$ ft to the northern limit of the survey area, may indicate the location of a linear, nonmetallic object below the surface (for example, a clay tile). Two GPR reflections along the trend can be seen in the left part of the profiles shown in Figures 8A and 8B, corresponding to $y = 160$ and $y = 165$ ft, respectively. The GPR reflections are subtle, and excavation will be necessary to confirm either the presence or absence of a buried object.

Immediately north of the building, the zone of strong GPR reflections is pronounced, particularly in the vicinity of a metal duct centered at grid coordinates (170, 155). Anomalies are observed in all of the potential-field data sets at this location, and they are primarily attributed to the metal duct. The GPR profiles shown in Figures 8A and 8B continue east immediately north of the metal duct to the east side of the survey area. Both profiles show reflections dipping to the west in the vicinity of the metal duct ($x = 170$ ft) and dipping back to the east further east along the profiles. The dipping reflections have a depth of about 4-5 ft. Unlike the anomalies delineated by the potential-field data, the GPR anomalies continue nearly 25 ft east of the metal duct to about $x = 200$ ft. While the GPR anomalies may be caused partly by buried objects, they are probably more indicative of the lateral extent of ground disturbance near the building.

Two east-west profiles on the east side of building are shown in Figures 9A and 9B, corresponding to $y = 130$ and $y = 140$ ft, respectively. As with profiles on the west side of the building, the profiles at the east side show a series of strong GPR reflections within the anomalous zone close to the building, located between the building ($x = 180$ ft) and $x = 220$ ft. The strongest reflectors appear to be within about 2 ft of the surface. Adjacent and north-south profiles are similar in character within the anomalous zone.

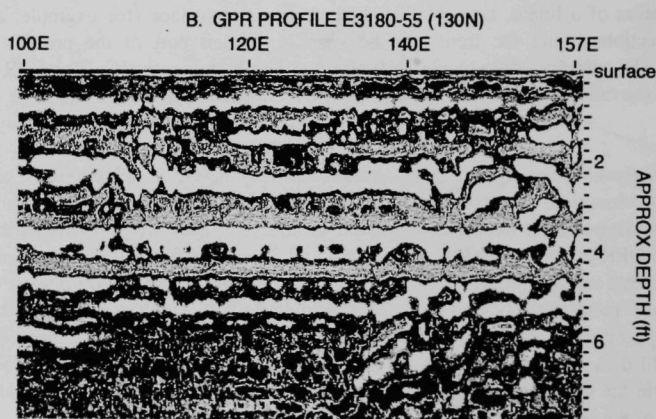
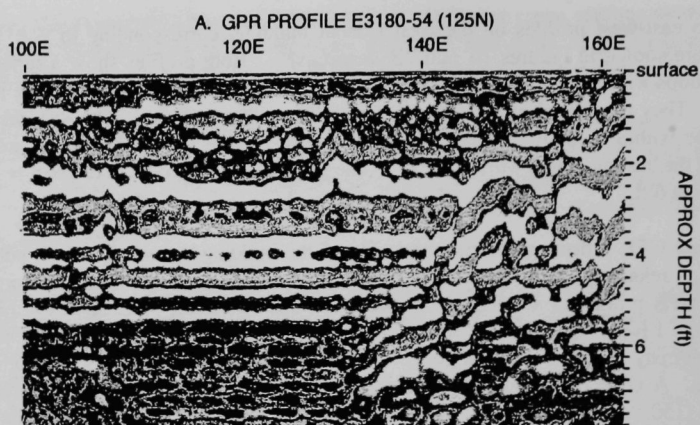


FIGURE 7 Two Adjacent West-to-East GPR Profiles on West Side of Building E3180

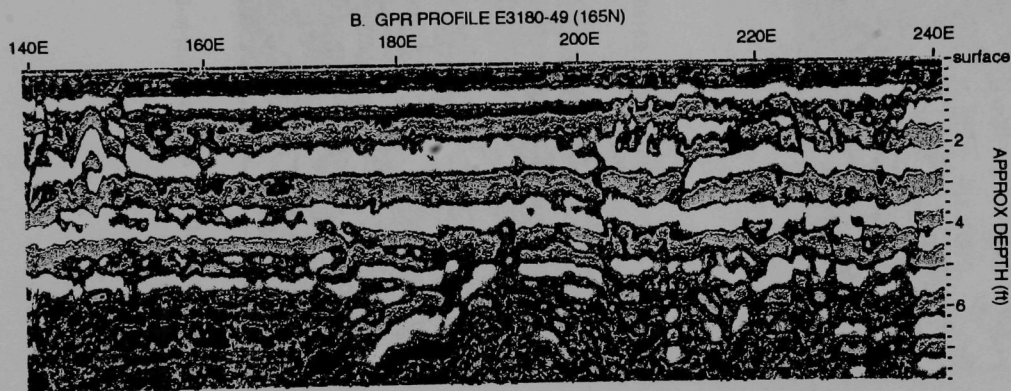
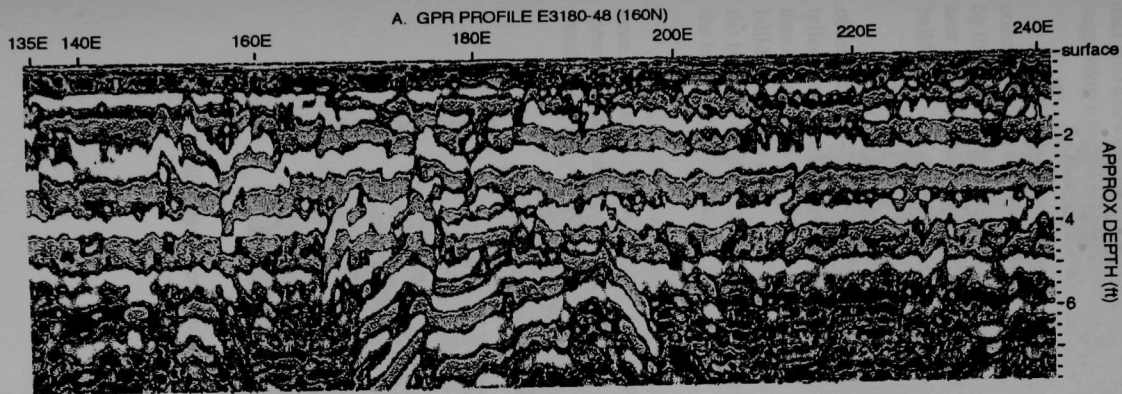


FIGURE 8 Two Adjacent West-to-East GPR Profiles on North Side of Building E3180

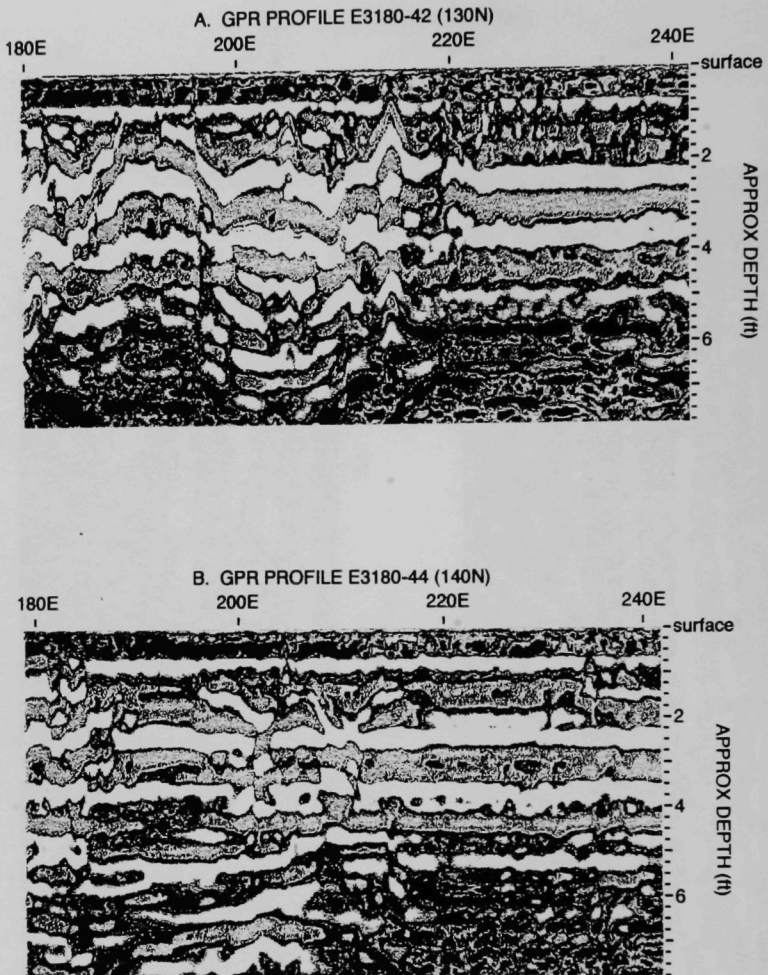


FIGURE 9 Two Nearly Adjacent West-to-East GPR Profiles on East Side of Building E3180

The strong reflection at about $x = 215$ ft in Figure 9A may be caused by the steel cable supporting the utility pole at grid coordinates (210, 125). However, the cable intersects the ground at grid coordinates (210, 130), whereas the GPR reflection is 5 ft further east. Magnetic and EMF data also show anomalies at the location of the GPR anomaly, at about grid coordinates (215, 130), suggesting a buried metallic source.

GPR reflections within about 10 ft of the building in Figures 9A and 9B ($x = 180$ -190 ft) coincide with a strong negative magnetic anomaly. The GPR reflections are somewhat distorted by the building; they do not suggest the presence of any large, metallic objects below the surface near the building. The magnetic anomalies are probably caused by metallic material in the building.

GPR anomalies south and southwest of the building were generally similar to reflections observed within the 35-ft anomalous zone on the other sides of the building. Anomalous reflections were generally observed at locations of the strong potential-field anomalies that were described above (Sections 3.1-3.3). However, the GPR anomalies at these locations (south of the building and between $x = 150$ and $x = 180$ ft) were similar to other GPR anomalies within 35 ft of the building (Figure 6). The presence of buried objects can neither be confirmed nor rejected on the basis of the GPR data.

Isolated GPR reflections are observed throughout the survey area beyond the anomalous zone. Examples are the anomalies north of $y = 170$ ft and east of about $x = 230$ ft. Generally, these anomalies occur without coinciding potential-field anomalies and do not have any discernible trend. They may be caused by bouncing of the antenna or other nongeologic effects.

4 Discussion

With the exception of areas close to the fence or the building, especially near the southwest corner and south walls of the building, much of the Building E3180 site had a relatively quiet response to potential-field measurements (Figures 3-5). A few anomalies were observed that were not associated with any obvious surface features (the building, metal conduit, fence, steel wire supporting the utility pole, etc.). Most of the anomalies, which were generally of low amplitude and isolated, were probably caused by buried metallic debris. One of the larger isolated anomalies, located at grid coordinates (130, 125) had a radius of about 5 ft in its EMF signature, a magnetic field contrast of less than 200 nT, and no apparent Geonics EM-31 response. The anomaly also produced a distinct GPR reflection (Figure 7A).

A stronger, perhaps important, group of anomalies was observed extending south from the southwest corner and the south wall of the building. The anomalies, located between $x = 160$ ft and $x = 175$ ft and between the building and the south edge of the survey area, were characterized by strong signatures in all three potential-field data sets. GPR data also showed anomalous reflections, although these reflections were not different from numerous others within about 35 ft of the building. The anomalies are in close proximity to a vertical pipe located at grid coordinates (165, 115) (Figure 2) and appear to be associated with a former pathway to the entrance of the building. The southern edge of the survey area is adjacent to a roadway that may contain gravels that affect the potential-field measurements. However, the relatively strong anomalies may also indicate the presence of one or more buried metallic objects. Excavation is required to determine the presence of buried metallic objects in these areas.

Strong potential-field anomalies elsewhere along the edge of the building may also be caused in part by underground metallic objects, particularly on the east side of the building, where the anomalies extend several feet from the building. However, these anomalies may be caused entirely by metallic material in the building. As before, excavation is required to determine the presence of buried metallic objects in areas close to the building.

The zone of anomalous GPR data around the perimeter of the building is probably caused by nonmetallic sources, with the exception of the anomalies described above and a few isolated anomalies described in Section 3.4. Similarly, the linear trend observed in GPR reflections along $x = 150$ ft in the northern part of the survey area has no apparent metallic source associated with it. It may be caused by a buried clay tile or other nonmetallic linear object.

5 Conclusions

Geophysical surveys around the Building E3180 site suggest that large buried metallic objects may occur between the building and the southern edge of the survey area or immediately adjacent to the building on the east, north, and west sides. Elsewhere around the site, buried metallic objects are probably of relatively limited size. Smaller anomalies (with a radius of 5 ft or less) are observed at a few locations. GPR data reveal that the ground within about 35 ft of the building has been disturbed. GPR data also show a north-trending anomaly northwest of the building that apparently is caused by a nonmetallic source.

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Coordinates of Ground-Penetrating-Radar

Attachment: Coordinates of Ground-Penetrating-Radar Profiles at Building E3180

**Attachment:
Coordinates of Ground-Penetrating-Radar Profiles at Building E3180**

Line No.	Coordinates (ft)			
	Start		End	
	X	Y	X	Y
1	Calibration line (begin W→E Lines)			
2	100	125	100	100
3	105	130	105	100
4	110	135	110	100
5	115	140	115	100
6	120	145	120	100
7	125	150	125	100
8	130	155	130	100
9	135	160	135	100
10	140	165	140	100
11	145	170	145	100
12	150	175	150	100
13	155	180	155	100
14	160	185	160	100
15	165	120	165	100
16	170	120	170	100
17	175	120	175	100
18	180	120	180	100
19	185	185	185	100
20	190	185	190	100
21	195	180	195	100
22	200	180	200	100
23	205	175	205	100
24	210	175	210	100
25	215	170	215	100
26	220	170	220	100
27	225	170	225	100
28	230	165	230	100
29	235	165	235	100
30	240	160	240	100

Line No.	Coordinates (ft)			
	Start		End	
	X	Y	X	Y
31	165	190	165	150
32	170	190	170	160
33	175	190	175	160
34	180	185	180	155
35	Calibration Line (Begin W→E Lines)			
36	100	100	235	100
37	100	105	240	105
38	100	110	240	110
39	100	115	240	115
40	100	120	240	120
41	180	125	240	125
42	180	130	240	130
43	180	135	240	135
44	180	140	240	140
45	185	145	240	145
46	185	150	240	150
47	175	155	240	155
48	135	160	240	160
49	140	165	240	165
50	145	170	225	170
51	150	175	210	175
52	160	180	200	180
53	160	185	190	185
54	100	125	160	125
55	100	130	157	130
56	105	135	155	135
57	115	140	155	140
58	120	145	160	145
59	125	150	160	150
60	130	155	160	155

ARGONNE
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LABORATORY

Appendix B:

Air Quality Monitoring Report

**ARGONNE
NATIONAL
LABORATORY**

INTRA-LABORATORY MEMO

April 6, 1995

TO: Eric Zimmerman

FROM: John Schneider JFS
Nancy Tomczyk

SUBJECT: Building E3180 Air Monitoring for Volatile Organic Compounds

Building E3180 was built in 1944 and was a facsimile of a Japanese pillbox used by the research and development community in the development of flame weapon systems. The building was not used from 1957 to 1965. From 1965 to the early 1970s, the building was used as a flame incendiary laboratory. From the early 1970s until 1988, the building was used as a metal working shop.

Air samples were collected and analyzed on-site at APG by ANL during the week of November 14, 1994. Samples were collected by drawing ambient air through a Tenax TA sorbent polymer sampling cartridge (4 mm I.D. \times 11.5 cm) traps, at the rate of 200mL for 120 minutes, yielding a 24 L sample volume. The cartridges were analyzed by thermally desorbing the trapped organic compounds with a Dynatherm model 900 ACEM thermal desorption unit on to a Hewlett-Packard 5890 series II gas chromatograph (GC) equipped with a Hewlett-Packard 5972 mass spectrometer (MS).

The MS was used for detecting and identifying organic compounds desorbed from the Tenax traps. Spectra were obtained by scanning from 45 to 400 atomic mass units at a rate of two scans every second. Identifications were based on mass spectral interpretation and computer searching of the 140,000 compound Wiley spectral library. A standard mixture of volatile organics containing toluene at 200 ng/uL and other aromatic hydrocarbons, was run daily to assure that the instrument was operating properly. All quantitations are estimates, using the assumption that analyte response factors should be similar to toluene in the standard mixture of volatile organics.

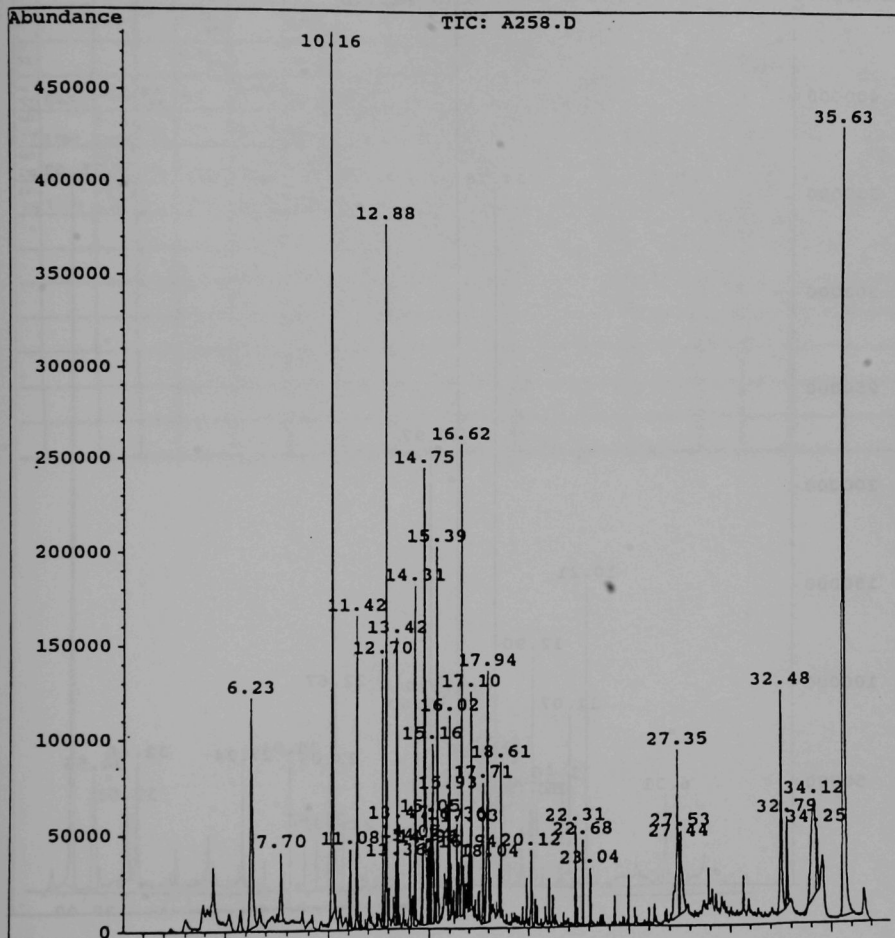
The majority of the volatile organic compounds found during the ANL air monitoring of Building 3180 are commonly found in any building (hydrocarbons and chlorinated solvents). The following compounds were the major components found in the air samples:

Compound	E3180	Outside SW
Benzene	0.15 ng/L	0.05 ng/L
Toluene	0.32 ng/L	0.08 ng/L
Hexanal	0.02 ng/L	0.04 ng/L
Tetrachloroethene	0.09 ng/L	0.02 ng/L
Ethyl Benzene	0.07 ng/L	0.02 ng/L
Xylenes	0.24 ng/L	0.06 ng/L
Alpha Pinene	0.08 ng/L	0.02 ng/L
Benzaldehyde	0.16 ng/L	0.14 ng/L
Phenol	0.02 ng/L	0.02 ng/L
Beta Pinene	0.05 ng/L	0.01 ng/L
Methyl Phenyl Ketone	0.09 ng/L	0.14 ng/L
Naphthalene	0.03 ng/L	0.02 ng/L

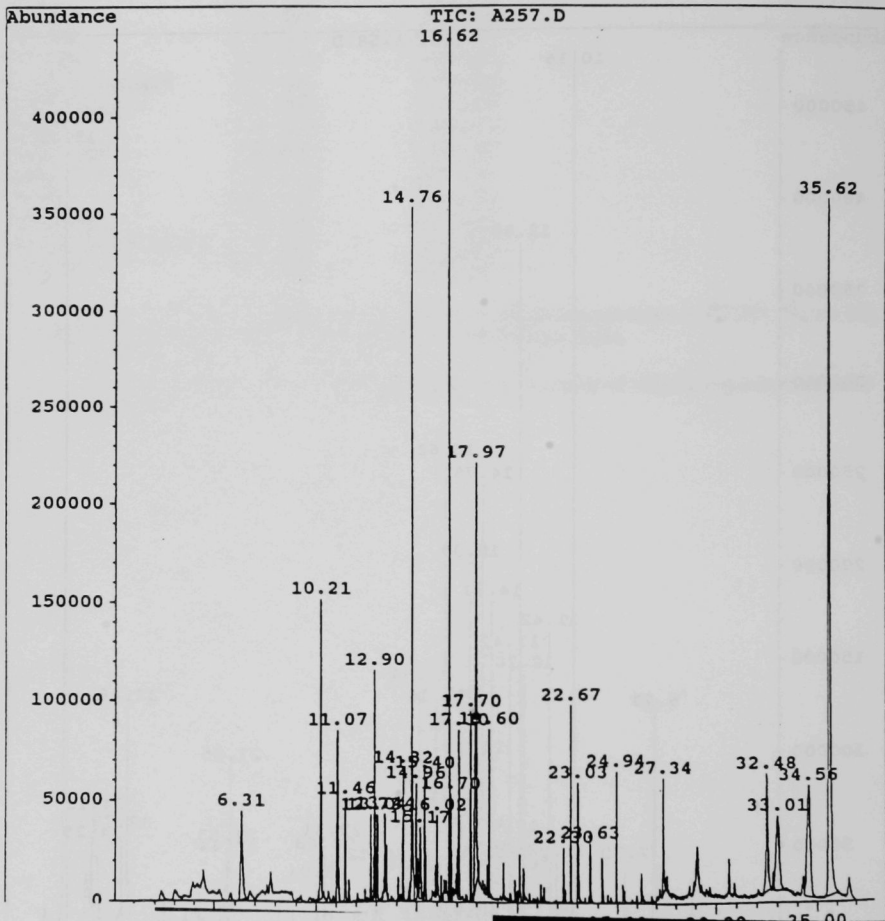
Figure 1 is a total ion chromatogram (TIC) of the air sample taken in E3180. Figure 2 is TIC of the outside air sample. Table 1 is the air sampling data sheet.

The analysis indicates that Building E3180 is not a source of volatile organic compound contamination.

File : A:\A258.D
Operator : lar
Acquired : 18 Nov 94 7:31 pm using AcqMethod PILOT
Instrument : 5972 - In
Sample Name: 258(58) E3180 inside 1:45-3:45 200mL/min
Misc Info : start, 200mL/min end facing ceiling, main rm
Vial Number: 1



File : A:\A257.D
Operator : lar
Acquired : 18 Nov 94 6:42 pm using AcqMethod PILOT
Instrument : 5972 - In
Sample Name: 257(45) E3180 outside 1:40-3:40 200mL/min
Misc Info : start, 200mL/min end SW corner facing ceilin
Vial Number: 1



Air Sampling Data Sheet

Site: <u>Montgomery</u> Researchers: <u>H. G. G. & R. P. P. & J. J. J. & J. J. J.</u>													
Sampling Specifications													
Location													
Ambient Conditions													
Building	Room	Sampling Time	Flow Rate	Pump	Pump ID #	Manifold	Height	Distance #1	Distance #2	Facing	Temp-ature	Pressure	Humidity
Start	End	Initial	Final	Setting									
43	ES163	12:02	300 $\frac{mL}{min}$	P-100	4	1 B	16"	12'		SW	64	-	90
47	ES163	12:12	300 $\frac{mL}{min}$	P-100	1	5 B	16"	11-E. Wall		N.E.	64	-	90%
51		12:15	300 $\frac{mL}{min}$					N.E. Wall		N.E.	64	-	90%
52		12:15	300 $\frac{mL}{min}$					N.E. Wall		N.E.	64	-	90%
43	ES163	12:30	200 $\frac{mL}{min}$	P-100	5	2 B	16"	NE of ES163			60°F		54%
47	ES163	1:40	300 $\frac{mL}{min}$	P-100	3	2 B	16"	5' from SW corner	8' from ceiling	Ceiling	71°F		93%
52	ES163	1:45	300 $\frac{mL}{min}$	P-100	2	4 B	16"	4' from S. wall	7' from NW corner	Ceiling	71°F		93%
53	ES163	1:45	300 $\frac{mL}{min}$	P-100	2	4 B	16"	4' from S. wall	7' from NW corner	Ceiling	71°F		93%

ARGONNE NATIONAL LAB WEST



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